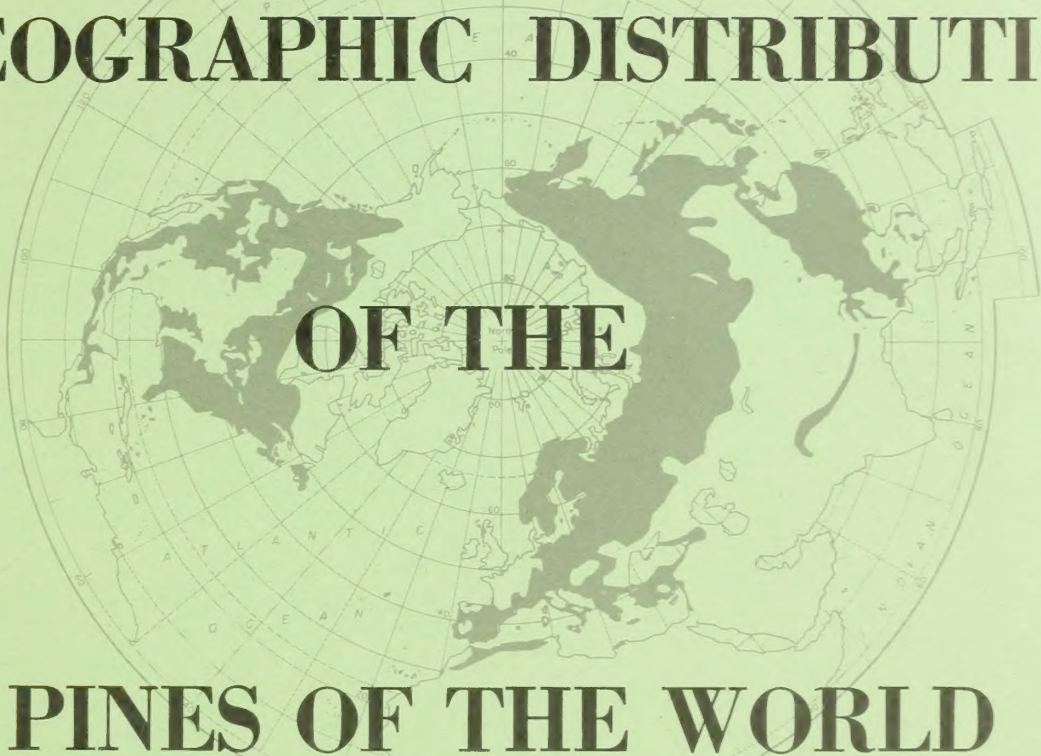


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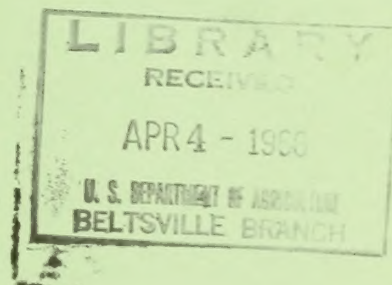
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GEOGRAPHIC DISTRIBUTION OF THE PINES OF THE WORLD

William B. Critchfield

Elbert L. Little, Jr.



**U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE**

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GEOGRAPHIC DISTRIBUTION OF THE PINES OF THE WORLD

by

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For their work in compiling and drafting the maps, the authors are greatly indebted to Audrey E. Kursinski and Barry K. Ford.

II

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GEOGRAPHIC DISTRIBUTION OF THE PINES OF THE WORLD

INTRODUCTION

The genus *Pinus* is one of the most widely distributed genera of trees in the Northern Hemisphere. In the North Temperate Zone it is rivalled only by *Quercus*, which has more species and may occupy a greater area. The pines extend from the polar region to the tropics, crossing the Equator at one point (Map 1). Within this enormous range, they dominate the natural vegetation in many regions. The genus includes some of the most valuable timber trees in the world, and is readily distinguished from other plants. For all of these reasons a great deal of information has accumulated about the natural distribution of the pines. This publication summarizes this information in the form of maps, and indicates the sources of information wherever possible.

A previous attempt to summarize information on the distribution of all the pines is that of Schmucker (1942), who included them in his survey of the distribution of the trees of the North Temperate Zone. His diagrammatic maps are small in scale (1:50,000,000 to 1:80,000,000), and his principal sources of information are indicated only in a general way.

The scope of this publication is limited to mappable information about where pines grow naturally at present. We have not tried to relate present distribution to the fossil record, nor have we tried to indicate the ecological and historical factors controlling species distribution. The elevations at which pines grow are mentioned only in the most general terms; this aspect of distribution is intimately related to latitude, topography, and other features of the local environment.

In relation to the evolution of *Pinus*, the arrangement of species maps has been made as meaningful as possible by grouping the species according to their presumed relationships. The classification of the soft or white pines, subgenus *Strobus* (*Haploxylon*), follows Shaw (1914, 1924). The hard pines, subgenus *Pinus* (*Diploxylon*), are arranged according to the relationship scheme of Duffield (1952), except that we have retained *Sabinianae* (group *Macrocarpae* of Shaw) as distinct.

We have brought up to date the names of the subdivisions of the genus *Pinus*, as explained in a separate report.¹ As indicated under Contents, the genus *Pinus* is divided here into 3 subgenera, 5 sections, 15 subsections, and 94 species. The rank subsection corresponds to that designated by some authors as series, "group," or section. One subgeneric name by another author is validly published here, and three names of subsections are proposed as new.

The geographic distribution or natural range of 94 species of *Pinus* (pine) is summarized and presented on 64 maps. Several other names are mentioned or combined as synonyms following conservative usage. English common names have been added.

Varieties and subspecies have not been mapped separately except in a few special cases. Many taxa of these ranks have been established on fragmentary evidence in *Pinus*, and cannot be considered mappable entities because of uncertainties or disagreement about their characterization or distribution.

¹ Little, Elbert L., Jr., and Critchfield, William B. Subdivisions of the genus *Pinus*. 1965 (Unpublished report on file at U.S. Forest Service, Washington, D.C.)

SOURCES OF INFORMATION

Forest trees of economic importance differ from most other plants in the very diverse kinds of information that can be used in mapping them. Publications for tree identification, floras, vegetation maps, forest-type maps, and a sizable part of the literature of forestry and plant ecology are sources. Travelers' accounts can occasionally be used, and zoological studies are sometimes helpful—for example, a report by J. T. Marshall (1957) on the birds of the pine-oak woodland of northern Mexico is an important source of information about pine species distribution in that region. Dot maps based on herbarium specimens convey only a fraction of the available information, and we have used them only for the pines of Mexico. The main source of distribution information about these Mexican species is Martínez (1948), who lists the localities where each species was collected. For the other pines, we have incorporated the available information into maps showing their total distribution, often with a special symbol (X) to indicate isolated or scattered occurrences.

The amount and quality of published information about where pines grow varies greatly from species to species and from country to country. The distribution of such economically important species as *Pinus ponderosa*, *P. sylvestris*, and *P. pinaster* is usually better known than that of species having little or no economic importance, such as *P. albicaulis*, *P. mugo*, and *P. pumila*.

The countries of eastern Asia present the greatest extremes in available information: The pines of Japan have all been mapped in detail at a large scale (Hayashi 1952, 1954), whereas the natural distribution and even the identity of some of the pines of eastern and northeastern China are uncertain. More is known about the distribution of pines in some of the remotest parts of western China than in eastern and southern China because of the remarkably concentrated plant exploration of parts of Kansu, Szechuan, Sikang, and Yunnan provinces (Cox 1945). In western and southern Europe, the distribution of the pines of Switzerland and Yugoslavia is more fully documented than that of most other countries. In the Western Hemisphere, poorly known areas include northwestern Canada, parts of the Great Basin and adjacent regions in western United States, parts of Mexico, and much of Honduras.

We have supplemented the published sources of information by having preliminary versions of all of the maps reviewed by specialists. The European and American species received a more thorough review than the Asian species. Information obtained from reviewers and cited here is filed at the Institute of Forest Genetics, Placerville, Calif. Additional working maps of the pines of the United States are in the files of the Forest Service dendrology project at Washington, D.C.

With certain exceptions, all of the published and unpublished sources of information are cited with brief notes on each species. Where a source pertains to only one or two countries, states, or provinces, these are indicated in parentheses. The following abbreviations are used for countries, states, and provinces:

Countries:	Abbreviation
Union of Soviet Socialist Republics	U.S.S.R.
United States of America	U.S.
States (U.S.):	
Arizona	Ariz.
California	Calif.
Colorado	Colo.
Florida	Fla.
Illinois	Ill.
Indiana	Ind.
Minnesota	Minn.
Missouri	Mo.
Montana	Mont.
Nebraska	Nebr.
Nevada	Nev.
New Hampshire	N.H.
New Mexico	N. Mex.
New York	N.Y.
North Carolina	N.C.
North Dakota	N. Dak.
Oregon	Oreg.
Pennsylvania	Pa.
South Carolina	S.C.
Washington	Wash.
Wyoming	Wyo.
Provinces (Canada):	
Alberta	Alta.
British Columbia	B.C.
Newfoundland	N.F.
Nova Scotia	N.S.
Ontario	Ont.
Quebec	Que.
States (Mexico):	
Aguascalientes	Ags.
Baja California	Baja Calif.
Chiapas	Chis.
Chihuahua	Chih.
Coahuila	Coah.
Durango	Dgo.
Guerrero	Gro.
Hidalgo	Hgo.
Jalisco	Jal.
México	Mex.
Michoacán	Mich.
Nayarit	Nay.
Nuevo León	N.L.
Oaxaca	Oax.
Puebla	Pue.
Querétaro	Qro.
San Luis Potosí	S.L.P.
Sinaloa	Sin.
Sonora	Son.
Tamaulipas	Tamps.
Veracruz	Ver.
Zacatecas	Zac.

All of the sources used for the distribution maps of the European and Asian pines are listed with the species notes. Additional source material, not listed with species notes, was used for the pines of the United States, for those of California in particular, and for the pines of Canada and Mexico.

United States.—Sargent (1884) was perhaps the first to record in detail the distribution of the native trees of the United States, including the genus *Pinus*, and to publish distribution maps of a few native pines. Afterwards he published revised ranges without maps in his *Silva* (1891-1902) and *Manual* (1905, 1922, 1926). Mohr (1897) prepared maps of the species of *Pinus* in southeastern United States.

Early work by the Forest Service on tree distribution maps has been reviewed by Little (1951). In charge of this work was George B. Sudworth, dendrologist with the former Bureau of Forestry from 1886 to 1905 and with the Forest Service thereafter until his death in 1927. Sudworth summarized ranges in his Check Lists (1898, 1927) and cited detailed distribution records in his *Forest Trees of the Pacific Slope* (1908). He and his assistants prepared distribution maps of most native tree species for publication under the title, "Forest Atlas—Geographic Distribution of North American Trees." Only Part I—Pines (Sudworth 1913), containing maps for 36 species of *Pinus*, appeared. Some smaller maps were issued in five bulletins on Rocky Mountain trees; one of them covered the pines (Sudworth 1917).

Munns (1938) published 170 maps of important forest trees of the United States, including 26 of pines, revised from Sudworth's older maps. Many of these maps were redrafted on a smaller scale and often with slight revisions in the Forest Service leaflets known as the American Woods series, several on pines, by Betts (1945). New small maps of 165 species including 20 pines were made for the 1949 *Agriculture Yearbook, Trees* (Little 1949). An atlas showing the distribution of the native tree species is in preparation (Little 1951).

The revised maps of the 36 species of *Pinus* native in the United States published here have incorporated with revisions the Forest Service maps prepared for other publications. These include maps of 18 species for the book, "Silvics of Forest Trees of the United States" (Fowells 1965), and maps for the forthcoming atlas.

In compiling these maps, the earlier Forest Service maps and other references mentioned above have been consulted, and the sources for the small maps in the 1949 Yearbook have been rechecked (Little 1951).

Current State floras (Blake and Atwood 1942; Gunn 1956) and tree books (Dayton 1952), several with maps by species and detailed range notes, have been important sources for plotting distribution on a large base map of the United States showing county boundaries. Some local floras have been checked, especially to fill in any gaps in State publications. Regional floras and tree publications have been helpful also. Maps of several native tree species, including a few pines, have appeared in monographic studies. Some general references for tree identification contain small maps.

Several State herbaria possess unpublished maps for each species showing by dots the counties or localities of the specimens collected. Credit is due the curators for permission to use this unpublished information. Where other records seemed inadequate, some herbarium specimens have been examined, for example, in a few States without species maps and for uncommon species of imperfectly known range.

The Forest Survey of the Forest Service has provided much detailed information on the distribution of commercial tree species. From measurements of trees on thousands of uniformly spaced sample plots within a State, highly accurate maps have been compiled, especially for the southeastern species (Janssen and Weiland 1960). States with distribution maps of commercial tree species published by the Forest Survey include: Virginia (Evans 1942), North Carolina (Roberts and Cruikshank 1941a), South Carolina (Roberts and Cruikshank 1941b), and Mississippi (Sternitzke and Duerr 1950).

Similar unpublished records of pines and other conifers by counties for other Southeastern States have been consulted.

Some very early western forest survey reports contained species maps not duplicated later. Forest type maps prepared mostly by the Forest Service have been published by States or regions. These have been helpful in mapping limits of dominant tree species, associated trees, and nonforested areas, particularly in western States of great altitudinal range and vegetation zonation. Vegetation maps have been prepared for some States, and one of the United States by Zon and Shantz (1924).

Accuracy of the latest maps has been improved through review by many foresters, both within the Forest Service and outside, and by botanists. Their assistance is acknowledged.

Principal sources, published and unpublished, for the maps of the 36 species of *Pinus* native in the United States are summarized below by States. California, with additional special sources, is discussed separately. *Pinus* is not native in Hawaii, Kansas, or Puerto Rico.

Alabama.—Harper (1928); Mohr (1901).

Alaska.—Hultén (1941); Sudworth (1908); Taylor and Little (1950).

Arizona.—Kearney and Peebles (1960); Little (1950). Unpublished maps by Robert A. Darrow at University of Arizona Herbarium.

Arkansas.—Moore (1960). Unpublished maps by Dwight M. Moore at University of Arkansas Herbarium.

California.—Jepson (1910); Munz and Keck (1963); Sudworth (1908). Special sources are cited on page 4.

Colorado.—Cary (1911); Harrington (1954). Unpublished maps by H. D. Harrington at Colorado State University Herbarium.

Connecticut.—Graves et al. (1910); Taylor (1915).

Delaware.—Taber (1960); Tatnall (1946).

District of Columbia.—Hermann (1946); Hitchcock and Standley (1919).

Florida.—Kurz and Godfrey (1962); Ward (1963); West and Arnold (1956).

Georgia.—Bishop (1948); Harper (1907-08); Thorne (1954). Unpublished maps by Wilbur H. Duncan at University of Georgia Herbarium.

Idaho.—Davis (1952); Johnson (1961); Kirkwood (1930); Merriam (1891); St. John (1963).

Illinois.—Jones and Fuller (1955); Miller and Tehon (1929).

Indiana.—Deam (1940); Deam and Shaw (1953).

Iowa.—Aikman and Hayden (1938); Campbell (1956).

Kentucky.—Braun (1913); Garman (1913). Unpublished maps by Edward T. Browne, Jr., at University of Kentucky Herbarium.

Louisiana.—Brown (1945); Cocks (1921).

Maine.—Hyland and Steinmetz (1944); Ogden, Steinmetz, and Hyland (1948).

Maryland.—Shreve et al. (1910); Tatnall (1946). Examination by Russell G. Brown of specimens at University of Maryland Herbarium.

Massachusetts.—Emerson (1875); Illick (1927).

Michigan.—Otis (1931); N. Smith (1952). Unpublished maps by John W. Andresen from specimens at University of Michigan Herbarium, Michigan State University Herbarium, and other herbaria.

Minnesota.—Rosendahl and Butters (1928). Specimens examined at University of Minnesota Herbarium.

Mississippi.—Lowe (1921); Sternitzke and Duerr (1950).

Missouri.—Settegren and McDermott (1962); Steyermark (1963).

Montana.—Booth (1950); Hutchison and Kemp (1952); Kirkwood (1930); Rydberg (1900); Standley (1921).

Nebraska.—Pool (1951).

Nevada.—Billings (1954); Linsdale, Howell, and Linsdale (1952); Little (1956).

New Hampshire.—Foster (1941).

Stone (1911); Taylor (1915).
 Little (1950); Wootton and Standley (1915).
 Brown (1921); Taylor (1915). Unpublished maps by O. G. Ogden and Stanley Smith at New York State College of Forestry, Albany.
 North Carolina.—Coker and Totten (1945); Pinchot and Wootton (1897); Roberts and Cruikshank (1941a). Unpublished maps by Albert E. Radford, Harry E. Ahles, and C. Ritchie Bell at University of North Carolina Herbarium.
 North Dakota.—Stevens (1950).
 Ohio.—Braun (1961); Transeau and Williams (1929).
 Oklahoma.—Phillips, Gibbs, and Mattoon (1939). Specimens examined at University of Oklahoma Herbarium.
 Oregon.—Benson (1930); Peck (1961); Randall (1957); Sudworth (1908).
 Pennsylvania.—Illick (1925). Unpublished maps by John M. Fogg, Jr., Edgar T. Wherry, and others at University of Pennsylvania Herbarium.
 Rhode Island.—Russell (1900).
 South Carolina.—Coker and Totten (1945); Roberts and Cruikshank (1941b). Unpublished maps by Albert E. Radford, Harry E. Ahles, and C. Ritchie Bell at University of North Carolina Herbarium.
 South Dakota.—McIntosh (1949); Over (1932); Ware (1936).
 Tennessee.—Shanks (1952). Unpublished maps by Aaron J. Sharp and Royal E. Shanks at University of Tennessee Herbarium.
 Texas.—Cory and Parks (1937); Gould (1962); McDougall and Sperry (1951); Texas Forest Service (1943); Vines and Arendale (1953).
 Utah.—Graham (1937). Unpublished thesis: Erdman, Kimball S. Classification and distribution of the native trees of Utah. 221 pp., illus. Brigham Young Univ., M. S. thesis. 1961.
 Vermont.—Burns and Otis (1916); Dole (1937).
 Virginia.—Evans (1942); Massey (1961).
 Washington.—Jones (1936); Mosher and Lunnum (1951); Piper (1906); St. John (1963); Sudworth (1908). Specimens examined at University of Washington Herbarium.
 West Virginia.—Brooks (1920); Strausbaugh and Core (1952). Unpublished maps by Earl L. Core and Elizabeth Ann Bartholomew at University of West Virginia Herbarium.
 Wisconsin.—Fassett (1930). Unpublished maps by John W. Andresen from specimens at University of Wisconsin Herbarium and other herbaria.
 Wyoming.—Cary (1917); McDougall and Baggley (1956); Porter (1959).

California.—Our principal sources of information for all of the pines that occur in California and adjacent parts of Nevada are the Vegetation Type Maps² and Soil-Vegetation Maps³ prepared by the Pacific Southwest Forest and Range

Experiment Station in cooperation with other agencies. We have also used the more detailed, unpublished information on which the older Vegetation Type Maps were based, Soil-Vegetation Maps currently being prepared for publication, data from the Forest Survey, and other unpublished information of the Pacific Southwest Forest and Range Experiment Station.

Canada.—Similar published references have been consulted for the maps of the eight species of *Pinus* native in Canada. Small distribution maps have appeared in the publication, Native Trees of Canada (Canada Department of Forestry 1961). Halliday and Brown (1943) mapped the distribution of important forest trees from forest survey data, and Rowe (1959) mapped and described the forest types of Canada. Principal additional published sources, including floras and tree and forestry publications by Provinces, are:

Alberta.—Moss (1959).
 British Columbia.—Garman (1963); Whitford and Craig (1918).
 Manitoba.—Lowe (1943); Scoggan (1957).
 New Brunswick.—Morison (1938); Roland (1947).
 Newfoundland.—Rouleau (1956).
 Nova Scotia.—Roland (1947).
 Ontario.—White and Hosie (1946).
 Quebec.—Hustich (1949); Marie-Victorin (1927, 1935).
 Saskatchewan.—Budd (1957); Fraser and Russell (1954).
 Yukon.—Hultén (1941); Porsild (1951).

Mexico.—The mapping of these pines differs from that of the other pines because of the scarcity of distribution information other than the small-scale distribution maps and the lists of collection localities in Martínez (1948). His lists are the chief source of information for the Mexican distribution of these species (the majority of the pines that occur in Mexico): *Pinus strobus*, *P. strobiformis* (as *P. ayacahuite* var. *brachyptera* and *P. reflexa*), *P. ayacahuite*, *P. cembroides*, *P. pinceana*, *P. nelsonii*, *P. leiophylla* (including *P. chihuahuana*), *P. lumholtzii*, *P. ponderosa* (as *P. arizonica*), *P. engelmannii*, *P. durangensis*, *P. cooperi* (as *P. lutea*), *P. montezumae*, *P. hartwegii* (including *P. rudis*), *P. michoacana*, *P. pseudostrobus* (including *P. tenuifolia*), *P. douglasiana*, *P. teocote* (including *P. herrerae*), *P. lawsonii*, *P. patula*, *P. greggii*, *P. oocarpa*, and *P. pringlei*.

Many of the place names listed by Martínez could not be located on the available maps. Most of the others were located with the assistance of a recent gazetteer (U.S. Board on Geographic Names 1956).

Another source of distribution information for many of the Mexican pines was the Mexican pine collection in the herbarium of the Institute of Forest Genetics at Placerville, Calif. Included in it are the 1960 and 1963 collections of E. L. Little, Jr., and the 1962 collections of North Carolina State College. We also used the species distribution map in the Guidebook to the Seminar and Study Tour of Latin American Conifers (Mexico Instituto Nacional de Investigaciones Forestales 1960). The approximate limits of the species were drawn with the help of topographic maps and several forest-type maps covering part or all of Mexico (Comisión Forestal del Estado Michoacán 1958; Mexico Instituto Nacional de Investigaciones Forestales 1960; Leopold 1950).

²Vegetation type and forest condition maps of California and western Nevada. September 20, 1963. U.S. Forest Serv., Pacific Southwest Forest and Range Expt. Sta., Berkeley, Calif. [List of available maps.]

³Timber stand and soil-vegetation maps of California. January 1963. U.S. Forest Serv., Pacific Southwest Forest and Range Expt. Sta., Berkeley, Calif. [List of available maps.]

SPECIES DISTRIBUTION, GENUS *PINUS* L.

SUBGEN. *DUCAMPOPINUS* (A. Cheval.) de Ferré

SECT. *DUCAMPOPINUS*

SUBSECT. *KREMPFLANI* Little & Critchfield[†]

Pinus krempfii Lecomte MAP 2a

Pinus krempfii Lecomte, Paris Mus. Natl. d'Hist.
Nat. Bul. 27: 191, fig. 1921.

This unique species—the only pine with flattened needles—is known only from the high mountains of southern Vietnam.

Sources:

Published—Bui 1962; Rollet 1955.

Unpublished—M. Schmid to N. T. Mirov 1961.

SUBGEN. *STROBUS* Lemm.

SECT. *STROBUS*

SUBSECT. *CEMBRAE* Loud.

Pinus koraiensis Sieb. & Zucc. MAP 2b Korean pine (see also Map 11)

Pinus koraiensis Sieb. & Zucc., Fl. Jap. 2: 28,
t. 116, fig. 5-6. 1844; exclud. fig. 1-4.

Korean pine ranges through Korea and eastern Manchuria into southeastern Siberia, with outliers on the Japanese islands of Honshu and Shikoku.

Sources:

Published—Hayashi 1952 (Japan); Solov'ev 1958 (U.S.S.R.); Uyeki 1926 (Korea); Wu 1956 (Manchuria).

Pinus pumila Regel MAP 3 Japanese stone pine (see also Map 4)

Pinus pumila Regel, Index Sem. Hort. Petrop.
1858: 23. 1859.

This pine ranges widely through northwestern Asia, extending north almost to the Arctic Ocean, east to the Bering Sea, west to northern Mongolia and Lake Baikal, and south to Korea and central Honshu, Japan. In the southern part of its range this shrubby, thicket-forming species is restricted to high elevations. Its presence on the Commander Islands east of Kamchatka is debatable; Tikhomirov (1949) shows it on one of the islands (Mednyy), but Tatewaki (1958) states that it is not present on either island.

[†] *Pinus* subgen. *Ducampopinus* (A. Cheval.) de Ferré, subgen. nov. *Pinus* sous-genre *Ducampopinus* (A. Cheval.) de Ferré, Paris Acad. Sci. Compt. Rend. 236: 228. 1953 (not validly published under ICBN Art. 33 because reference to basionym lacked original publication with page). *Ducampopinus* A. Cheval., Rev. Bot. Appl. d'Agr. Trop. 24: 30. 1944. Holotype species: *Pinus krempfii* Lecomte, Paris Mus. Natl. Hist. Bul. 27: 191, fig. 1921.

[‡] *Pinus* subgen. *Ducampopinus* sec. *Ducampopinus* subsect. *Krempfiani* Little & Critchfield, subsect. nov. Characteribus subgeneris *Pinus* subgen. *Ducampopinus* (A. Cheval.) de Ferré. Folio cum 1 fasciculo vasculare, 2

In the past this species has generally been considered a variant of the *Pinus cembra*—*P. sibirica* group of eastern Siberia and Europe, but recent investigators consider it more closely allied to the Japanese *P. parviflora* (de Ferré 1960; Malyshev 1960).

Sources:

Published—Hultén 1926; Imanishi 1950 (Manchuria); Kung 1934 (Manchuria); Malyshev 1960 (Siberia); Takahasi 1944 (Manchuria); Tatewaki 1958 (Kurile Islands); Tikhomirov 1949; Utkin 1961 (Siberia); Uyeki 1926 (Korea); Wu 1956 (Manchuria).

Pinus sibirica Du Tour MAP 4 Siberian stone pine

Pinus sibirica Du Tour, Nouv. Dict. Hist. Nat. 18: 18. 1803.

Siberian stone pine ranges from the Ural Mountains through western and central Siberia to northern Mongolia, with outliers on the Kola Peninsula of northern Russia. This species is the Siberian counterpart of the central European *Pinus cembra*. Its range overlaps that of *P. pumila* in the region of Lake Baikal, Siberia. *P. sibirica* sometimes assumes a shrubby growth form like that of *P. pumila*, and the two are often confused (Malyshev 1960).

Sources:

Published—Hultén 1950 (Kola Peninsula); Lavrenko and Soczava 1956; Nekrasova 1949 (Kola Peninsula).

Pinus cembra L. MAP 4 Swiss stone pine

Pinus cembra L., Sp. Pl. 1000. 1753.

Swiss stone pine grows at high elevations in the Alps and the Carpathian Mountains. It is closely related to *Pinus sibirica*, from which it is separated by a 1,500-mile gap.

Sources:

Published—Fekete and Blattny 1913-1914; Generali 1937 (Italy); Marchesoni 1959 (Italy); Ozenda 1961 (France); Rubner 1953, p. 364; Scharfetter 1938; Schmid 1949 (Switzerland).

Unpublished—Forestry Research Institute, Rumania, 1964; M. Vidaković 1964 (Yugoslavia).

Pinus albicaulis Engelm. MAP 5 whitebark pine

Pinus albicaulis Engelm., Acad. Sci. St. Louis Trans.
2: 209. 1863.

Whitebark pine occurs at high elevations from central British Columbia south to the southern Sierra Nevada of

in fasciculo, anguste lanceolata, valde complanata (1.5-4 mm. late minute serrulata vel integra, stomatibus ventralibus atque raro dorsalibus ductis resiniferis subexternis, et vagina mox decidua. Bases bractearum non decurrentes. Strobilus junioris solitarius, sine aculeis. Strobili ovoides, symmetricales, aperti postquam maturi. Squamae carinatae, apophysi crassa pyramidata et umbone dorsali. Semina cum ala longa articulata. Lignum modice durum, leviter resinosum, annulis incrementi, sine tracheidiis radiis, alburno albo luteolo, ligno interiore colore salmonis. A subgeneribus aliis differt foliis complanatis atque absentia tracheidiarum radiis. Holotypus: *Pinus krempfii* Lecomte, Paris Mus. Natl. Hist. Nat. Bul. 27: 191, fig. 1921.

the Ruby Mountains of Nevada, and the mountains of western Wyoming. Through much of its range it is characteristic of timberline, where it often forms dense stands. Its distribution is still not fully known. Many places it grows are relatively inaccessible, and in the mountain and southeastern part of its range it is often confused with *Pinus flexilis*. The cones of the two species differ, but because of similarities in most other features there is considerable uncertainty about their relative distribution in areas of overlap.

Additional sources:

Published—Ayres 1900a (Mont.), 1900b (Mont.); Bailey and Bailey 1941; Bedwell and Childs 1943 (Wash.); Leiberg 1897 (Idaho), 1900b (Oreg.), 1900c (Idaho), 1904a (Mont.), 1904b (Mont.).

File report—"Blister rust occurrence survey in the Marble Mountains, Klamath National Forest" by Benton Howard, October 4, 1956. Forest Service, Region 5, San Francisco, Calif.

Unpublished—T. C. Brayshaw and A. E. Porsild 1964 (B.C.); J. F. Franklin 1963 (Oreg. and Wash.); J. R. Griffin 1963 (Calif.); F. D. Johnson 1963, 1964 (Idaho); O. V. Matthews 1964 (Calif.); H. Weaver 1963 (Wash.).

SUBSECT. STROBI Loud.

***Pinus strobus* L.**
eastern white pine

MAP 6

Pinus strobus L., Sp. Pl. 1001. 1753.

Eastern white pine ranges from Newfoundland through southern Canada to southeastern Manitoba, through the Lake States south to Iowa and Illinois, and throughout much of northeastern United States, south in the Appalachian Mountains to northern Georgia. A discontinuity of more than 1,200 miles separates it from a southern variant usually called *Pinus strobus* var. *chiapensis* Martínez. This Middle American white pine grows at low and middle elevations in southern Mexico and Guatemala.

Additional sources:

Published—Aguilar 1961 (Guatemala); Crespo 1963 (Pue.); Haddow 1948a and 1948b (Ont.); Miranda and Sharp 1950; Sharp 1946 (Guatemala); Standley and Steyermark 1958 (Guatemala); Wagner 1962 (Chis.).

Unpublished—T. C. Brayshaw and A. E. Porsild 1964 (Canada); B. Hallberg 1964 (Oax.).

***Pinus monticola* Dougl.**
western white pine

MAP 6

Pinus monticola Dougl. ex D. Don in Lamb., Descr.

Genus *Pinus*. Ed. 3 (8°), v. 2, unnumbered page between p. 144 and p. 145. 1832.

Western white pine ranges from southern British Columbia to northern Idaho, northwestern Montana, and eastern Oregon, and south through the Cascade Mountains to the southern end of the Sierra Nevada, Calif. It is separated from the closely related *Pinus strobus* by more than 1,000 miles. In the northern part of its range *P. monticola* nearly reaches sea level in places, but in the Sierra Nevada it is a high-elevation tree. Early reports of this species in the mountains of southern California (Sudworth 1908) apparently were the result of confusion with either *P. flexilis* or *P. lambertiana*.

Additional sources:

Published—Ayres 1900a and 1900b (Mont.); Baker 1951 (Oreg.); Leiberg 1900a (Mont.), 1900b (Oreg.).

Unpublished—R. T. Bingham 1964 (Idaho); T. C. Brayshaw and A. E. Porsild 1964 (Canada); J. F. Franklin 1964 (Oreg.); J. L. Jenkinson 1963 (Oreg.); F. D. Johnson 1964 (Idaho); O. V. Matthews 1964 (Oreg.); R. Schmidt 1964 (B.C.); C. A. Wellner 1964.

***Pinus lambertiana* Dougl.**

MAP 7

sugar pine

Pinus lambertiana Dougl., Linn. Soc. London Trans. 15: 500. 1827.

Sugar pine ranges from western Oregon through the North Coast Range of California, the Sierra Nevada, and the mountains of southern California, with outliers in the Santa Lucia Mountains of west-central California and the Sierra San Pedro Martir of northern Baja California.

Additional sources:

Published—Baker 1956 (Oreg.); Goldman 1916 (Baja Calif.); Langille et al. 1903 (Oreg.); Leiberg 1900b (Oreg.); Ornduff and French 1958 (Oreg.).

Unpublished—B. K. Ford 1963 (Calif.); J. F. Franklin 1964 (Oreg.); J. R. Griffin 1964 (Calif.); J. L. Jenkinson 1963 (Calif. and Oreg.); O. V. Matthews 1964 (Oreg.); W. I. Stein 1964 (Oreg.).

***Pinus flexilis* James**
limber pine

MAP 8

Pinus flexilis James, Exped. Rocky Mts. 2: 27, 35. 1823.

Limber pine ranges through the Rocky Mountains from southern Alberta and British Columbia to northern New Mexico, extending west through the mountain ranges of the Great Basin to southern California, western and northern Nevada, and eastern Oregon. It grows at high elevations through much of its range, but in Canada and the northern United States it is often confined to the prairie margins at the lower edge of the forest zone. It may be more widespread than the map shows on the poorly-known mountain ranges of the Great Basin. In the northern and western parts of its range it is often confused with *Pinus albicaulis*. It overlaps and to some extent intergrades with *P. strobiformis* at the southern edge of its range. Its southern limits are based on information provided by J. W. Andresen and R. J. Steinhoff from an unpublished investigation of variation in these two species (see below).

Additional sources:

Published—Ayres 1900a and 1900b (Mont.); Bacigalupi 1933 (Calif.); Bailey and Bailey 1941; Douglass and Douglass 1955 (Colo.); Goodding 1923 (Nebr.); Howell 1951 (Calif.); Leiberg 1904b (Mont.); Peck 1947 (Oreg.); Potter and Green 1964 (N. Dak.).

Theses—S. J. Preece, Jr. 1950. Floristic and ecological features of the Raft River Mountains of northwestern Utah. M.S. thesis, Univ. Utah, 103 pp., illus.; Raphael J. Steinhoff 1964. Taxonomy, nomenclature, and variation within the *Pinus flexilis* complex. Ph.D. thesis, Michigan State Univ., 81 pp., illus.

Unpublished—J. W. Andresen 1963; W. H. Baker 1961 (Idaho); R. T. Bingham 1963 (Mont.); T. C. Brayshaw and A. E. Porsild 1964 (Canada); W. C. Bullard 1963 (Calif.); D. B. Coombs 1963 (Alta.); W. C. Cumming 1963 (Nev.); Margaret M. Douglass 1962 (Colo.); L. W. Hoskins 1963 (Nev.); F. D. Johnson 1964 (Idaho); O. V. Matthews 1964 (Idaho); M. A. McCollm 1963 (Nev.); R. A. Read 1964 (Nebr.).

***Pinus strobiformis* Engelm.**

MAP 8

southwestern white pine

(see also Map 9)

Pinus strobiformis Engelm. in Wislitz., Mem. Tour
North. Mex. 102. 1848.

Southwestern white pine extends from the southern part of Colorado through the mountains of Arizona, New Mexico, western Texas, and northern Mexico as far south as San Luis Potosí. Common synonyms for *Pinus strobiformis* include *P. flexilis* var. *reflexa* Engelm., *P. reflexa* (Engelm.) Engelm., and *P. ayacahuite* var. *brachyptera* Shaw. This species forms a link, both geographically and morphologically, between its neighbors *P. flexilis* and *P. ayacahuite*. The northern limits of *P. strobiformis* are based on information supplied by J. W. Andresen and R. J. Steinhoff (see *P. flexilis*) and Margaret M. Douglass (as *P. flexilis* var. *macrocarpa* Engelm.). Southwestern white pine is apparently separated from its southern relative, *P. ayacahuite*, by a 100-mile gap that does not seem to correspond to any comparable discontinuity in suitable habitats.

Additional sources:

Published—Bailey 1913 (N. Mex.); Gentry 1942, 1946 (Sin.); Johnston 1943 (Coah.); J. T. Marshall 1957; Plummer 1904 (Ariz.); Plummer and Gowsell 1904 (N. Mex.); Rixon 1905 (N. Mex.); G. C. Rzedowski 1960 (S.L.P.); Zobel and Cech 1957 (N.L.).

Thesis—James H. Maysilles 1956. Floral relationships of the pine forests of western Durango. Ph.D. thesis, Univ. Mich., 165 pp., illus.

Unpublished—J. W. Andresen 1964; M. B. Applequist 1964 (Ariz.); Margaret M. and J. R. Douglass 1962 (Colo.); E. Larsen 1962 (México); R. J. Steinhoff 1963 (Colo.); O. Zarzosa L. 1964 (Dgo.).

***Pinus ayacahuite* Ehrenb.**

MAP 9

Mexican white pine

Pinus ayacahuite Ehrenb. in Schlecht., Linnaea 12: 492. 1838.

Mexican white pine grows at high elevations from Jalisco and Hidalgo through central and southern Mexico to Guatemala, El Salvador, and western Honduras. In northern Mexico it is replaced by the closely related *Pinus strobiformis*. The single collection from western Jalisco is, according to Martínez (1948, p. 126), morphologically intermediate between these two white pines.

Additional sources:

Published—Allen 1955 (Honduras); Castaños 1962 (Oax.); Hinds and Larsen 1961 (Jal.); Schwerdtfeger 1953 (Guatemala); Standley and Steyermark 1958 (Guatemala); Wagner 1962 (Chis.).

Unpublished—P. H. Allen 1962 (El Salvador); B. Hallberg 1964 (Oax.).

***Pinus peuce* Griseb.**

MAP 10

Balkan pine

Pinus peuce Griseb., Spicil. Fl. Rumel. Byth.
2: 319. 1844.

This species is confined to the high mountains of southeastern Europe—southern Yugoslavia, western Bulgaria, northern Greece, and Albania. It is morphologically similar to the blue pine of the Himalayas, *Pinus griffithii*, from which it is separated by more than 3,000 miles.

Sources:

Published—Buffault 1931 (Greece); Heske 1959a (Albania); Markgraf 1932; Rikli 1943-1946.

Unpublished—B. Pejowski (n.d.) to N. T. Mirov.

***Pinus armandii* Franch.**

MAPS 11 AND 12

Armand pine

Pinus armandii Franch., Paris Mus. Hist. Nat.

Nouv. Arch., Sér. 2, 7: 95-96, t. 12. 1885; "armandii."

This white pine of moderate and high elevations has a notably disjunct distribution. It ranges through western and southwestern China from Shansi and Kansu south to Yunnan and Kweichow, and west to northern Burma, extreme northeastern India, and southeastern Tibet. It is also present on the islands of Hainan and Taiwan and on two islands just south of Kyushu, Japan—Yaku Shima and Tanega Shima. In 1924 it was discovered in the Tsangpo Valley of southeastern Tibet by the plant explorer F. Kingdon Ward (Marquand 1929, Ward 1941b). Not until 1940 was it reported on the higher mountains of southern Hainan (Merrill and Chun 1940).

We have tentatively included here a five-needled pine recently discovered in the mountains of western Anhwei Province, China. The description of this pine, *Pinus anhweiensis*, has apparently not been published, but the locality where it was found has been reported by Wei (1963).

Another little-known white pine, found near Hué in central Vietnam, has been variously classified as *Pinus armandii* (Chevalier 1944), *P. excelsa* (*P. griffithii*) (Chevalier 1919), and part of the *P. fenzeliana* complex (de Ferré 1960; see *P. fenzeliana* and Map 14).

Sources:

Published—Cheng 1932 (Kweichow), 1939 (Szechuan); C. K. Chow 1947 (Kansu); Diels 1900 (Szechuan); Farrer 1926 (Kansu, Szechuan); Handel-Mazzetti 1927 and 1929-1936 (Szechuan, Yunnan); Hers 1922 (Honan); Hsu 1950 (Yunnan); Kabanov 1962 (Kansu, Shensi); Ku and Cheo 1941 (Szechuan); Limpricht 1922 (Szechuan); Ludlow 1951 (Tibet); Marquand 1929 (Tibet); Merrill 1941 (Burma); Merrill and Chun 1940 (Hainan); Orr 1933 (Yunnan); Rehder 1923 (Shensi); Rock 1947 (Yunnan); Schweinfurth 1957; H. Smith 1925 (Shansi); Teng 1940 (Szechuan, Yunnan), 1947 (Kansu); Walker 1941 (Kansu); Wang 1961; Ward 1924 (Yunnan), 1941c (Burma), 1949 (Burma), 1952b (Assam); Wilson 1907 (Hupeh), 1913 (Hupeh, Szechuan), 1916 (Japan), 1926 (Yunnan); Wu 1956.

Thesis—Chung-lwen Wu 1947. The phytogeographical distribution of pine in China. M.F. thesis, Yale Univ., 74 pp., illus.

Unpublished—Forest Research Institute, Taiwan, to N. T. Mirov 1961 (Taiwan); Shiu-ying Hu 1963; Wang Chi-Wu 1964.

***Pinus griffithii* McClelland**

MAP 12

blue pine

(see also Map 14)

Pinus griffithii McClelland in Griffith, Notul.

Pl. Asiatic. 4: 17. 1854; Icon. Pl. As. 4, t. 365, excl. fig. 1-3. 1854.

Blue pine has also been known as *Pinus excelsa* Wall., *P. wallichiana* A. B. Jacks., and *P. chylla* Lodd. It ranges throughout the Himalaya Mountains, extending beyond them to eastern Afghanistan, northeastern Baluchistan (West Pakistan), northern Burma, and Yunnan Province, China. It is an important component of the middle- and high-elevation Himalayan forests, especially in the drier inner valleys. Its eastern outliers in southeastern Tibet and northern Burma have been found by the plant explorer F. Kingdon Ward within the past few decades. Only recently it has been observed in the central part of India's Northeast Frontier Agency (approximately 28° N. lat., 90° E. long.), where it may have been introduced (Fürer-Haimendorf 1955, pp. 18, 62).

Sources:

Published—Aitchison 1879, 1881-82 (Afghanistan); Banerji 1958 (Nepal); Bor 1938 (Assam); Burkill 1909 (Baluchistan); Cooper 1933 (Bhutan); Duthie 1893 (Kashmir), 1898 (Pakistan); Fürer-Haimendorf 1955 (Assam); Gammie 1898

Unpublished—Wang Chi-Wu 1964 (Burma, China).

Sources:

Unpublished—Arnold Arboretum Herbarium: *W. T. Tsang* 28496 (N. Kwangsi).

MAP 14

Nat. Bul. 95: 178, fig. 2, 3. 1960.

Source:

Published—de Ferré 1960.

MAP 13

2: 27, t. 115, 1844.

Sources:

Published—Hayashi 1954 (Japan); Uyeki 1926 (Korea).

MAP 14

3, 43: 194, 1908.

Source:

Unpublished—Forest Research Institute, Taiwan, to N. T. Mirov 1961.

MAP 14

80: 337. 1931.

We are including here *Pinus kwangtungensis* Chun ex Tsiang (Tsiang 1948), which appears to be synonymous with *P. fenzeliana*. Also included is a white pine of central Vietnam which de Ferré (1960) has tentatively classified as *P. fenzeliana* on the basis of a vegetative specimen. This Vietnam pine had earlier been variously referred to *P. excelsa* (*P. griffithii*) (Chevalier 1919) and *P. armandii* (Chevalier 1944).

MAP 14

Bul., n.s., 1: 191. 1948.

Source:

Published—Hu and Cheng 1948.

SUBJECT. *CEMBROIDES* Engelm.

MAP 15

(see also Map 17)

München, Abhandl. Math.-Phys. 1: 392. 1832;

Flora [Jena] 15 (2), Beibl. 93. 1832.

Additional sources:

Unpublished—C. E. Blanco 1964 (Dgo., Coah.); F. Medel-Lin-Leal 1964 (S.L.P.); O. Zarzosa L. 1964 (Dgo.).

MAP 17

pinyon

Pinus edulis Engelm. in Wisliz., Mem. Tour
North. Mex. 88. 1848.

Pinyon is widespread in the southwestern United States, just entering Wyoming and extending south through Utah, Colorado, and New Mexico to the western end of Oklahoma, west Texas, and the northern border of Chihuahua; extending west throughout much of Arizona to an outlier in eastern California. Its range overlaps that of the Mexican pinyon, *Pinus cembroides*, in southern Arizona and New Mexico. *P. edulis* also overlaps, and may occasionally intergrade with, *P. monophylla* at the western edge of its range. The relative distribution of these two species has been confused by the prevalence of a single-leaved form of *P. edulis* in central Arizona south of the Mogollon Rim, but it has been established that this form is a variation of *P. edulis* (Little 1950, p. 12).

Additional sources:

Published—Deaver and Haskell 1955 (Ariz.); Jack 1900 (Colo.); Leiberg et al. 1904 (Ariz.); Merriam 1890 (Ariz.); Peterson 1962 (Wyo.); Plummer and Gowsell 1904 (N. Mex.); Sudworth 1900a (Colo.); Weber 1961 (Colo.); Wolf 1938 (Calif.).

Thesis—W. D. Stanton 1931. A preliminary study of the flora of the Henry Mountains of Utah. M.A. thesis, Brigham Young Univ., 63 pp., illus.

Unpublished—W. P. Cottam 1964.

***Pinus quadrifolia* Parl.**

MAP 16

Parry pinyon

Pinus quadrifolia Parl. ex Sudw., U. S. Dept. Agr.
Div. Forestry Bul. 14: 17. 1897.

Parry pinyon is confined to low elevations in the dry mountains of southern California and northern Baja California from the San Jacinto Mountains south to the Sierra San Pedro Martir. Its range overlaps that of *Pinus monophylla*, but no intermediates have been reported. All of the sources listed below pertain to Baja California.

Additional sources:

Published—Goldman 1916; Wiggins 1944.

Unpublished—Reid Moran 1963, 1964; J. Olmsted 1962.

***Pinus monophylla* Torr. & Frém.** MAPS 16 AND 17
singleleaf pinyon

Pinus monophylla Torr. & Frém. in Frém., Rpt.
Explor. Exped. Rocky Mts. 319, t. 4. 1845;
"monophyllus."

Singleleaf pinyon is widespread and common at low elevations in the isolated mountain ranges of the Great Basin, ranging from southern Idaho, western Utah, and northwestern Arizona through most of Nevada and eastern and central California to northern Baja California. It overlaps *Pinus edulis* in southwestern Utah, northwestern Arizona, and the New York Mountains of southern California, and intermediate forms are known. This species was once thought to extend into central Arizona (Munns 1938), but the single-leaved pinyon of that region is now considered a variation of *P. edulis* (Little 1950, p. 12). The range of *P. monophylla* has recently been extended more than 100 miles south, in Baja California (Anonymous 1963; Reid Moran 19319).

Additional sources:

Published—Anonymous 1963; Bailey and Bailey 1941; Goldman 1916 (Baja Calif.); Merriam 1893; Wiggins 1940 (Baja Calif.).

Thesis—C. McMillan 1948. A taxonomic and ecological study of the flora of the Deep Creek Mountains of central western Utah. M.S. thesis, Univ. Utah, 99 pp., illus.

Unpublished—W. C. Bullard 1963 (Calif.); W. P. Cottam 1964 (Utah); G. K. Griffith 1963 (Nev.); L. W. Hoskins 1963 (Nev.); M. Humphreys 1963 (Nev.); F. D. Johnson 1964 (Idaho); M. A. McCollm 1963 (Nev.); J. H. Thomas 1964 (Baja Calif.); W. W. Wagener 1963 (Calif.).

***Pinus culminicola* Andresen & Beaman** MAP 18
Potosi pinyon

Pinus culminicola Andresen & Beaman, Arnold
Arboretum Jour. 42: 438, fig. 2-4, 1961.

This recently named species is the only high-elevation pinyon. It has been found only on Cerro Potosi, possibly the highest mountain in Nuevo León, where it grows as a timberline shrub (Andresen and Beaman 1961) and in the forest understory. It had previously been identified as *Pinus flexilis* (Muller 1939).

***Pinus maximartinezii* Rzedowski**

MAP 15

Martinez pinyon

Pinus maximartinezii Rzedowski, Ciencia 23: 17,
fig. 1-3, t. 2. 1964

This remarkable new pinyon is known only from its type locality, the Cerro de Piñones in the southern part of Zacatecas, Mexico, near the town of Juchipila. Discovered only in 1963, it is notable among the pinyons for its very large cones (Rzedowski 1964).

***Pinus pinceana* Gord.**

MAP 18

Pince pinyon

Pinus pinceana Gord., Pinet. 204. 1858.

This pinyon is restricted to a few areas in northeastern and eastern Mexico from central Coahuila to central Hidalgo, and is nowhere common. It is often associated with *Pinus cembroides*, the common pinyon of Mexico.

Additional sources:

Published—Johnston 1943 (Coah., Zac.); Díaz Luna 1962 (S.L.P.); McVaugh 1952 (Qro.).

***Pinus nelsonii* Shaw**

MAP 18

Nelson pinyon

Pinus nelsonii Shaw, Gard. Chron. Ser. 3,
36: 122, fig. 49. 1904; "nelsoni."

This pinyon is confined to a few scattered localities in northwestern Mexico, from southern Coahuila, southern Nuevo León, and western Tamaulipas to San Luis Potosí. One of the rarest of the Mexican pines, it is associated with the common Mexican pinyon, *Pinus cembroides*.

Additional sources:

Published—Crespo 1963 (Tamps.); Mirov 1961 (Tamps.).

SUBSECT. *GERARDIANAE* Loud.

***Pinus gerardiana* Wall.**

MAP 19a

chilgoza pine

Pinus gerardiana Wall. ex D. Don in Lamb., Descr.

Genus Pinus. Ed. 3 (8°), v. 2, unnumbered page
between p. 144 and p. 145, t. 79. 1832.

This species, noted chiefly for its large edible seeds, is confined to the mountains of eastern Afghanistan, parts of Pakistan, and scattered localities in the dry inner valleys of the northern Himalayas. It may be more widely distributed than the map shows in Waziristan, along the Afghanistan-Pakistan border. It is separated from *Pinus bungeana*, its only close relative, by the 1,300-mile-long Tibetan highland.

Sources:

Published—Aitchison 1879, 1881-1882 (Afghanistan); Burkill 1909 (Baluchistan); Clarke 1957 (Afghanistan); Duthie 1898 (Pakistan); Linchevsky and Prozorovskiy 1949 (Afghanistan); Schweinfurth 1957; Stebbing 1906 (Baluchistan).

Unpublished—E. Nasir 1963 (Pakistan); R. J. Rodin 1963 (Pakistan); G. L. Webster 1963 (Kashmir).

Pinus bungeana Zucc. in Endl., Synops. Conif.
166. 1847.

Dark pine grows in northern China from northern Honan and Hupeh north to Shansi and Hopeh. Notable for its peculiar Platanus-like bark, this pine is comparatively rare throughout its range.

Published—Cheng 1939 (Szechuan); H. F. Chow 1934 (Hopeh); Hers 1922 (Honan); Hu 1935 (Honan); H. Smith 1925 (Shansi); Sowerby 1937; Tang 1931 (Shansi); Teng 1947 (Kansu); Wilson 1907 (Hupeh).

Unpublished—Wang Chi-Wu 1964 (Shensi).

SUBSECT. *BALFOURIANAE* Shaw

Pinus balfouriana Grev. & Balf. MAP 20
foxtail pine (see also Map 21)

Pinus balfouriana Grev. & Balf. in A. Murr., Bot.

Exped. Oreg. [Rpt. No. 8] No. 618, t. 1853.

Foxtail pine is confined to two high-elevation areas about 300 miles apart: the southern Sierra Nevada, Calif., and the higher mountains of northwestern California from the South Yolla Bolly Mountains north to the Marble Mountains. The stands on the east slope of the Sierra Nevada are about 20 miles from stands of *Pinus aristata* in the Inyo Mountains, only the width of the arid Inyo Valley separating the two species at this point. A northern outlier of the Sierra Nevada distribution reported by Sudworth (1908, p. 41) on the divide between the South Fork of the San Joaquin River and the North Fork of the Kings River has never been verified, and is not included in the distribution shown on the map.

Additional sources:

Published—Howell 1951.

File reports—"Survey of foxtail pine in northern California" by T. H. Harris and Benton Howard, August 28, 1956. Forest Service, Region 5, San Francisco, Calif.; "Blister rust occurrence survey in the Marble Mountains, Klamath National Forest" by Benton Howard, October 4, 1956. Forest Service, Region 5, San Francisco, Calif.

Unpublished—D. V. Hemphill 1964 (northern Calif.).

Pinus aristata Engelm. MAP 21
bristlecone pine (see also Map 20)

Pinus aristata Engelm. in Parry & Engelm., Amer.

Jour. Sci. and Arts, Ser. 2, 34: 331. 1862.

Bristlecone pine ranges from eastern California through Nevada, Utah, and northern Arizona to Colorado and northern New Mexico. It grows at high elevations and frequently extends to timberline. In many places it is very localized, but in others, such as the White Mountains of eastern California, it forms extensive stands. It is probably more widely distributed in the poorly known mountain ranges of Nevada than the map indicates.

Additional sources:

Unpublished—W. P. Cottam 1964 (Utah); Margaret M. Douglass 1962 (Colo.); C. W. Ferguson 1962 (Calif.); R. D. Wright 1962 (Calif.).

SUBGEN. *PINUS*

SECT. *TERNATAE* Loud.

SUBSECT. *LEIOPHYLLAE* Loud.

Pinus leiophylla Schiede & Deppe MAP 22
Chihuahua pine

Pinus leiophylla Schiede & Deppe in Schlecht. & Cham., Linnaea 6: 354. 1831.

Chihuahua pine ranges from southern and central Mexico through western Mexico to southwestern New Mexico and southern and central Arizona. Included here is *Pinus leiophylla* var. *chihuahuana* (Engelm.) Shaw, sometimes considered a separate species, *P. chihuahuana* Engelm. *P. leiophylla* is unique among American pines in having cones that require three seasons to mature. Its northernmost known occurrences are just south of the Mogollon Rim in central Arizona (7 miles west of Pinedale—Sudworth 1927; about 25 miles east of Payson—M. B. Applequist, personal communication, 1964). Additional sources:

Published—Goldman 1951; Guzmán and Vela 1960 (Zac.); J. T. Marshall 1957 (Son., Chih.); Shaw 1909.

Thesis—James H. Maysilles 1959. Floral relationships of the pine forest of western Durango, Mexico. Ph.D. thesis, Univ. Michigan, 165 pp., illus.

Unpublished—M. B. Applequist 1964 (Ariz.); B. Hallberg 1964 (Oax.); E. Larsen 1962; N. Sánchez Mejorada to L. W. Bryan 1963 (Mich.); O. Zarzosa L. 1964 (Dgo.).

Pinus lumholtzii Robins. & Fern. MAP 23
Lumholtz pine

Pinus lumholtzii Robins. & Fern., Amer. Acad.
Proc. 30: 122. 1895.

This species grows at relatively low elevations in northwestern Mexico, from Sonora and Chihuahua south to Jalisco. It is notable for its pendent but stiff needles.

Additional sources:

Published—Gentry 1942, 1946 (Sin.); Guzmán and Vela 1960 (Zac.); Shaw 1909 (Nay.).

Thesis—James H. Maysilles 1959. Floral relationships of the pine forests of western Durango, Mexico. Ph.D. thesis, Univ. Michigan, 165 pp., illus.

Unpublished—C. E. Blanco 1964 (Dgo.); E. Larsen 1962; O. Zarzosa L. 1964 (Dgo.).

SUBSECT. *CANARIENSES* Loud.

Pinus canariensis C. Smith MAP 24b
Canary Island pine

Pinus canariensis C. Smith in Buch, Phys. Besch.
Canar. Ins. 159. 1825.

Canary Island pine is confined to the central and western Canary Islands, off the coast of northwestern Africa. Its only close relative, *Pinus roxburghii*, grows in the Himalaya Mountains more than 5,000 miles away.

Sources:

Published—Ceballos and Ortuño 1951.

Unpublished—L. Ceballos to N. T. Mirov (n.d.) (Gran Canaria).

***Pinus roxburghii* Sarg.**

MAP 24a

chir pine

Pinus roxburghii Sarg., Silva No. Amer. 11: 9. 1897.

This species, long known as *P. longifolia* Roxb., is confined to the monsoon belt of the outer Himalayas from Bhutan to the northeastern part of West Pakistan. It grows at low elevations (generally below 7,000 feet). Early reports to the contrary, it apparently has not been found in Afghanistan except in cultivation (Aitchison 1891). Its distribution in Nepal and Bhutan is only sketchily known. It has not been reported east of Bhutan, but this part of India is almost unexplored botanically (Schweinfurth 1957).

It is separated by more than 5,000 miles from its closest relative, *Pinus canariensis*.

Sources:

Published—Banerji 1958 (Nepal); Biswas 1933; Burkill 1910 (Nepal); R. E. Cooper 1933 (Bhutan); Gammie 1898 (India); Gorrie 1933 (India); Kawakita 1956 (Nepal); Malik 1962 (Pakistan); Osmaston 1922 (India); Pirson 1962 (India); Polunin 1950 (Nepal); Schweinfurth 1957; S. Singh 1929 (Kashmir); Smith and Cave 1911 (Sikkim); Tilman 1952 (Nepal); Troup 1921 (India); L. H. J. Williams 1953 (Nepal).

Unpublished—R. J. Rodin 1963 (Pakistan).

SUBSECT. PINEAE Shaw

***Pinus pinea* L.**

MAP 25

Italian stone pine

Pinus pinea L., Sp. Pl. 1000. 1753.

Italian stone pine is widespread on the Iberian peninsula (Spain and Portugal), ranges along the northern and eastern shores of the Mediterranean Sea, and occurs at a few places near the north coast of Turkey. It is the only Eastern Hemisphere species with cones that require three seasons to develop to maturity. It is also notable for its edible seeds, and has been widely planted for many centuries. Its natural range is highly uncertain (Rikli 1926), but we have omitted those stands known to be artificial in origin, such as the well-known forest near Ravenna, Italy.

Sources:

Published—Briquet 1910 (Corsica); Buffault 1931 (Greece); Chodat 1913 (Portugal); Feinbrun 1959 (Lebanon); Gaussen 1953-1954 (France); Heske 1959a (Albania); Holmboe 1914 (Cyprus); Kayacik 1957 (Turkey); Knoche 1921 (Balearic Islands); Philippson 1895 (Greece), 1919 (Turkey); Rechinger 1943 (Greece); Rikli 1926; Touring Club Italiano 1958 (Italy); Turrill 1929.

Unpublished—Director-General, Forest Services of Portugal, 1964; H. Gaussen 1964 (France); General-Director of Forestry, Turkey, 1964; Instituto Forestal de Investigaciones y Experiencias, Spain, 1962; B. Kasapligil to N. T. Mirov 1961 (Turkey); H. Kayacik 1964 (Turkey); E. Magini to N. T. Mirov 1960 (Italy); C. Mouloupoulos 1964 (Greece); A. de Philippis 1964 (Italy).

SECT. PINUS

SUBSECT. SYLVESTRES Loud.

***Pinus resinosa* Ait.**

MAP 26

red pine

Pinus resinosa Ait., Hort. Kew. 3: 367. 1789

Red pine ranges through southern Canada from Newfoundland to southeastern Manitoba, and south through the Lake States and the northeastern United States, with outliers in Illinois and West Virginia. This species is the only representative of this typically Eurasian group of pines on the North American mainland. Its closest relative is probably *Pinus nigra* of southern Europe.

Additional sources:

Published—Brenneman 1956 (Ill.); Cook, Smith, and Stone 1952 (N.Y.); Haddow 1948a and 1948b (Ont.).

Unpublished—T. C. Brayshaw and A. E. Porsild 1964 (Canada); Gary Saunders (N.F.).

***Pinus tropicalis* Morelet**

MAP 26

tropical pine

Pinus tropicalis Morelet, Rev. Hort. Côte d'Or
1: 106. 1851.

This species is confined to the Isle of Pines and the low mountains of Pinar del Rio Province, western Cuba. It is separated from *Pinus resinosa*, the only other Western Hemisphere representative of this group, by more than a thousand miles.

Sources:

Published—E. E. Smith 1954; Marie-Victorin and Léon 1942.

***Pinus nigra* Arnold**

MAP 27

Austrian pine

Pinus nigra Arnold, Reise Mariazell 8, t. 1785.

Austrian pine ranges widely through southern Europe from Spain to Austria and throughout much of the Balkan Peninsula, east to southern Russia and south to Turkey; on the islands of Cyprus, Sicily, and Corsica, with outliers in Algeria and Morocco. Its variability in nature, recently described by Röhrig (1957), is reflected in the great taxonomic complexity of this species (Schwarz 1936).

Austrian pine is associated with several related species in various parts of its range, including the closely similar *Pinus heldreichii* and the widespread *P. sylvestris*. Within the limited range of *P. heldreichii*, that species and *P. nigra* are sometimes confused.

Reports of *Pinus nigra* on the Mediterranean islands of Crete and Rhodes are apparently in error (Rechinger 1951).

Sources:

Published—Akademia Nauk SSSR 1954 (U.S.S.R.); Anić 1957 (Yugoslavia); Bernhard 1931 (Turkey); Buffault 1931 (Greece); Comité de Géographie du Maroc 1957 (Morocco); Debazac 1963 (France), 1964 (Corsica); Dudič 1953 (Yugoslavia); Fekete 1959 (Rumania); Fekete and Blattny 1913-1914 (Yugoslavia); Fukarek 1958; Gaussen (n.d.) and 1953-1954 (France, Spain); Giacobbe 1937 (Italy); Heske 1954 (Turkey), 1959a (Greece); Jovančević 1961 (Yugoslavia); Kayacik 1954 (Turkey); Kosanin 1929 (Yugoslavia); Maire and Peverimhoff 1927 (Algeria); Markgraf 1932 (Albania); Miletic 1959 (Yugoslavia); Pejowski 1956 (Yugoslavia); Philippson 1895 (Greece); Rechinger 1951 (Greece); Rubner and Reinhold 1953, fig. 74 (Crimea); Salvador 1927 (Spain); Scharfetter 1938 (Austria); Vidaković 1957 (Yugoslavia).

—Forestry Research Institute, Rumania, Director of Forestry, Turkey, 1964; Instituto de Investigaciones y Experiencias, Spain, 1962; B. Magini to N. T. Mirov 1961 (Turkey); H. Kayacik 1964 (Italy); R. Morandini 1964 (Italy); A. de Philippis 1961 and 1964 (Italy); E. Röhrig 1964 (Austria).

***Pinus heldreichii* Christ**

MAP 28

Heldreich pine

Pinus heldreichii Christ, Naturf. Gesell. Basel Verhandl. 3: 549. 1863.

This pine is confined to high elevations on the Balkan peninsula (central Yugoslavia to northern Greece and southwestern Bulgaria) and in southern Italy. Since it is sometimes confused with its much more widespread associate, *Pinus nigra*, its range is not yet fully established. Within the past few years its known distribution in Montenegro (Lakušić 1961) and Serbia (Tošić 1959) has been considerably enlarged.

Sources:

Published—Delevoy 1948; Fukarek 1941; Gourlay 1938 (Greece); Heske 1959a (Albania); Jedlowski 1959 (Italy); Lakušić 1961 (Yugoslavia); Longhi 1956 (Italy); Markgraf 1931; Tošić 1959 (Yugoslavia).

Unpublished—E. Magini to N. T. Mirov 1960 (Italy: Campania); C. Mouloupoulos 1964 (Greece).

***Pinus mugo* Turra**

MAP 29

Swiss mountain pine

Pinus mugo Turra, Gior. Ital. (Grisilini) 1: 152. 1764.

Pinus mugo (*P. montana* Mill.) grows at high elevations in the mountains of central and southern Europe (Alps, Pyrenees, Carpathians, Balkans), ranging east and south to the U.S.S.R., Rumania, Bulgaria, and central Italy, north to Germany and Poland, and west to eastern Spain, where the species reaches its southern limit. It ranges in form from a dwarfed bush to a small tree. The tree form, which is prevalent in the Pyrenees and the western Alps, is sometimes segregated as *Pinus uncinata* Ramond. The unusually complex nomenclature of this pine is based primarily on its variable growth form and cones (Willkomm 1861, Kirchner et al. 1908).

Pinus mugo is associated with the closely related *P. sylvestris* in many parts of its range, and the two are believed to hybridize in nature (Fitschen 1930, p. 430).

Sources:

Published—Adamović 1909; Akademia Nauk SSSR 1954 (U.S.S.R.); Beck 1901 (Yugoslavia); Ceballos 1941 (Spain); Čermák et al. 1955 (Czechoslovakia); Fekete and Blattny 1913-1914; Fukarek 1959 (Yugoslavia); Gaussen 1923 (France), 1956 (France, Spain); Giordano 1962b (Bulgaria); Kirchner et al. 1908; Košanin 1929 (Yugoslavia); Markgraf 1932 (Albania); Merxmüller 1954; Scharfetter 1938 (Austria); Schmid 1949 (Switzerland); Touring Club Italiano 1958 (Italy); Willkomm 1861.

Unpublished—Forestry Research Institute, Rumania, 1964; J.F. Lacaze 1963 (France); R. Morandini 1964 (Italy); S. Bialobok 1964 (Poland).

***Pinus pinaster* Ait.**

MAP 30

maritime pine

Pinus pinaster Ait., Hort. Kew. 3: 367. 1789.

Maritime pine ranges from the Iberian peninsula (Spain, Portugal) through southern France to the west coast of Italy,

in northern Africa from Morocco to Tunisia, and to the islands of Corsica and Sardinia. Its natural distribution has been somewhat obscured by the widespread planting of this species. We have excluded the extensive planted stands in southwestern France and northwestern Spain, but a portion of the distribution of this species in Portugal is certainly of artificial origin.

Sources:

Published—Comité de Géographie du Maroc 1957 (Morocco); Desole 1960 (Sardinia); Gaussen (n.d.) (France, Spain), 1953-1954 (France); Gaussen and Vernet (n.d.) (Algeria, Tunisia); Guinier 1952; Rikli 1943-1946; Serviço de Reconhecimento e de Ordenamento Agrário 1962 (Portugal); Touring Club Italiano 1931 (Italy).

Unpublished—H. Gaussen 1964 (France); Instituto Forestal de Investigaciones y Experiencias 1962 (Spain); A. de Philippis 1961 and 1964 (Italy).

***Pinus halepensis* Mill.**

MAP 31

Aleppo pine

Pinus halepensis Mill., Gard. Dict. Ed. 8, Pinus No. 8. 1768.

Aleppo pine is widely distributed in the Mediterranean region, ranging from Morocco to Tunisia and Libya (Cyrenaica) in North Africa, with outliers extending to the northern edge of the Sahara Desert; from eastern Spain through southern France and Italy to the Adriatic coast of Yugoslavia and to Greece; at the eastern end of the Mediterranean Sea from Israel and Jordan north to Turkey. *Pinus brutia* replaces this species in the northeastern part of the Mediterranean region, and the two are known to hybridize in the region of overlap (see *P. brutia*). The natural occurrence of *P. halepensis* on the island of Corsica is uncertain; Nahal (1962b) and H. Gaussen (personal communication, 1964) indicate that it occurs in one place, but Briquet (1910) states that it is not native to the island.

Sources:

Published—Beck 1901 (Yugoslavia); Comité de Géographie du Maroc 1957 (Morocco); Feinbrun 1959 (Lebanon); Francini 1953 (Italy); Gaussen 1953-1954 (France); Giordano 1962a (Lebanon); Heske 1959a (Greece); Kasapgil 1956 (Jordan); Kayacik 1954 (Turkey); Maire 1926 (Algeria, Tunisia); Markgraf 1932 (Albania); Mikesell 1961 (Morocco); Nahal 1962a (Syria), 1962b (France, Corsica); Touring Club Italiano 1931 (Italy); Turrill 1929 (Greece); Zohary 1947 (Israel, Jordan).

Unpublished—Instituto Forestal de Investigaciones y Experiencias, Spain, 1962; H. Kayacik 1962, 1964 (Turkey); H. G. Keith 1961 (Libya); E. Magini to N. T. Mirov 1960 (Italy); R. Morandini 1964 (Italy); J. Papaioannou 1964 (Greece); A. de Philippis 1961 and 1964 (Italy); M. Vidaković 1964 (Yugoslavia).

***Pinus brutia* Ten.**

MAP 31

Pinus brutia Ten., Prodr. Fl. Nap. Ixxii. 1811.

This close relative of *Pinus halepensis* largely replaces that species in the eastern Aegean region, Turkey, the Levant, on the Mediterranean islands of Crete and Cyprus, and in the Black Sea region. The ranges of the two overlap in northeastern Greece, where they hybridize (Papaioannou 1936), in the Levant (Feinbrun 1959, Nahal 1962a), and in southeastern Turkey (Kayacik 1954).

Variants of *Pinus brutia* in the Black Sea region are sometimes called *P. pithyusa* Stev. and *P. eldarica* Medw. *P. pithyusa* grows along the northern and northeastern shores of the Black Sea, *P. eldarica* on a single low mountain (Eilar-Ugi) in the central Transcaucasus.

Pinus brutia or one of its variants has long been thought to occur naturally in Iran and Afghanistan, and Papaioannou's map of the distribution of this species (in Nahal 1962b) shows it in these countries. Planted in both countries, it is especially common in Afghanistan (Aitchison 1891, Clarke 1957). But comparatively intensive recent botanical explorations of these two countries have failed to find any natural stands of this pine (Bobek 1951; Kitamura 1960; Linchevsky and Prozorovsky 1949; Zohary 1963; J. Papaioannou, personal communication, 1964). Aitchison (1891) attempted to track down rumors of natural forests of this pine, but found only planted trees. The source of seed of this common Afghanistan pine remains an intriguing question, since the nearest natural stands of the species are almost 1,000 miles from Afghanistan. Sources:

Published—Akademia Nauk, SSSR, 1954 (U.S.S.R.); Alemdag 1962 (Turkey); Bernhard 1931 (Turkey); Chaturvedi 1961 (Syria); Czeczott 1954; Feinbrun 1959 (Lebanon); Giordano 1962a (Lebanon); Heske 1954 (Turkey), 1959a (Greece), 1959b (Iraq); Kayacik 1954 (Turkey); Ketskhovali 1960 (U.S.S.R.); Maléjeff 1929 (U.S.S.R.); Nahal 1962a (Syria); Radde 1899 (U.S.S.R.); Rechinger 1951 (Greece); Rubner and Reinhold 1953 (U.S.S.R.); Selik 1959 (Turkey). Unpublished—General Director of Forestry, Turkey, 1964; H. Kayacik 1964 (Turkey); E. D. Michaelides 1961 (Cyprus); J. Papaioannou 1964.

***Pinus sylvestris* L.**

MAP 32

Scotch pine

Pinus sylvestris L., Sp. Pl. 1000. 1753.

The most widely distributed of the pines, Scotch pine grows throughout northern Eurasia from Scotland, southern Spain, northern Greece, and northern Turkey to northern Manchuria and the Sea of Okhotsk. In Europe it is associated with several related species, including *Pinus mugo* and *P. nigra*. A principal source of information for our map is the excellent distribution map by Steven and Carlisle (1959). Sources:

Published—Akademia Nauk, SSSR, 1954 (U.S.S.R.); Bernhard 1931 (Turkey); Čermák et al. 1955 (Czechoslovakia); Coutinho 1939 (Portugal); Fekete and Blattny 1913-1914; Fenzel 1932-1933 (Manchuria); Gaussen 1953-1954 (France), 1956 (France, Spain); Georgescu 1939 (Rumania); Gulisašvili 1951 (Transcaucasus); Heske 1954 (Turkey); Hesper and Feldman 1954 (West Germany); Hultén 1950 (Northern Europe); Karlberg 1960 (Turkey); Kayacik 1954 (Turkey); Ketskhovali 1960 (Transcaucasus); Murzaev 1955 (Manchuria); Rubner and Reinhold 1953 (Crimea); Seifriz 1935 (Transcaucasus); Shimaniuk 1962 (Siberia); Stefanović 1958 (Yugoslavia); Steven and Carlisle 1959; Touring Club Italiano 1958 (Alps).

Unpublished—S. Bialobok 1964 (Yugoslavia); H. Gaussen 1964 (France); General Director of Forestry, Turkey, 1964; Instituto Forestal de Investigaciones y Experiencias, Spain, 1964; B. Kasapligil to N. T. Mirov 1961 (Turkey); H. Kayacik 1964 (Turkey); JF. Lacaze 1964 (France); E. Magini to N. T. Mirov 1960 (Italy); R. Morandini 1964 (Italy); C. Mouloupoulos 1964 (Greece); A. de Philippis 1961, 1964 (Italy); Pilar Rifé to N. T. Mirov 1961 (Spain); M. Vidaković 1964 (Yugoslavia); J. W. Wright 1960.

***Pinus densiflora* Sieb. & Zucc.**

MAP 33

Japanese red pine

Pinus densiflora Sieb. & Zucc., Fl. Jap. 2: 22, t. 112. 1844.

Pinus densiflora, including *P. funebris* Komarov, is widely distributed in Japan from northern Honshu to Yaku Shima,

south of Kyushu; from Korea to eastern Manchuria and adjacent U.S.S.R.; and on the Shantung Peninsula of China. Hayashi (1952) maps it at a single locality in southern Hokkaido, but this stand was probably planted (M. Kusaka, personal communication, 1964) and has been omitted from our map. The distribution of *P. densiflora* on the mainland of Asia, especially in southern Manchuria and eastern China, is still uncertain, partly because this species has been confused with several other east-Asian hard pines. Wu (1956) shows its range extending westward to include the Liaotung Peninsula of southern Manchuria, but Takahasi (1944) states that *P. densiflora* is confined to a small area in the southern part of eastern Manchuria. We have omitted the Liaotung region from the range shown on the map.

Sources:

Published—Akademia Nauk, SSSR, 1954 (U.S.S.R.); Fenzel 1932-1933 (Manchuria); Hayashi 1952 (Japan); Liu 1928 (Shantung); Loesener 1920 (Shantung); Uyeki 1926 (Korea).

Unpublished—M. Kusaka 1964 (Hokkaido, Korea); N. T. Mirov 1961 (Korea).

***Pinus thunbergiana* Franco**

MAP 34

Japanese black pine

Pinus thunbergiana Franco, Lisboa Inst.

Super. Agron. An. 16: 130. 1949.

Japanese black pine, a maritime species, grows on three of the principal islands of Japan—Honshu, Kyushu, and Shikoku—and in southern Korea. Its southern limit, according to Hayashi (1952), is Takara Island in the Tokara group at about 29° N. latitude, but Wilson (1920) reports that *Pinus luchuensis* is the only pine in this island group. *P. thunbergiana* is very similar to *P. nigra* of southern Europe and the Mediterranean region. This species was long known as *P. thunbergii* Parl. (not Lamb.).

Sources:

Published—Hayashi 1952 (Japan); Uyeki 1926 (Korea).

***Pinus massoniana* Lamb.**

MAP 35

Masson pine

Pinus massoniana Lamb., Descr. Genus Pinus

1: 17, t. 12. 1803.

Pinus massoniana is widely distributed in China, ranging from Shantung, Kiangsu, and northern Taiwan west to Szechuan and south to northern Vietnam. A collection from the Amoy hills in Merrill's list of Hainan plants (Merrill 1927) is probably wrongly attributed to Hainan; F. P. Metcalf (1942) lists the same specimen for Fukien Province, where the city of Amoy is located.

We have followed Wu (1956) in including here the little-known *Pinus henryi* Masters (*P. massoniana* var. *henryi* (Masters) Wu). Shaw (1914) considered this pine, found in Hupeh and adjoining areas, a variant of *P. tabulaeformis*.

Pinus massoniana is widely planted, and through much of its range is the only species of pine present. On many of the mountains of eastern and central China it is replaced at higher elevations by *P. hwangshanensis*.

Sources:

Published—Bui 1962 (Vietnam); Cheng 1932 (Kweichow), 1939 (Szechuan); Handel-Mazzetti 1927 and 1929-1936 (Kweichow); Law 1947 (Kiangsu); Liu et al. 1960 (Honan); F. P. Metcalf 1942 (Fukien); Pendleton 1933 (Kwangtung); Steward and Cheo 1935 (Kwangsi); Wang 1961; Wilson 1913 (Hupeh); Wu 1956.

Unpublished—Forest Research Institute, Taiwan, 1964; N. T. Mirov 1961 (Taiwan); Kuo Pao-chang 1963 (Shantung).

***Pinus taiwanensis* Hayata**

MAP 36

a pine

Pinus taiwanensis Hayata, Tokyo Col. Sci. Jour.
30 (Art. 1): 307. 1911.

This pine grows at middle and high elevations in the mountains of central Taiwan. It is closely related to *Pinus insularis*, of the Ryukyu Islands northeast of Taiwan, and *Pinus hwangshanensis*, of mainland China.

Sources:

Unpublished—Forest Research Institute, Taiwan, to N. T. Mirov 1961.

***Pinus luchuensis* Mayr**

MAP 36

Luchu pine

Pinus luchuensis Mayr, Bot. Centralbl.
58: 149, fig. 1894.

This low-elevation species is confined to the Ryukyu Islands between Japan and Taiwan. It is the only pine on the islands from Yonaguni, the southwesternmost of the Ryukyus, to Amami-Oshima, northeast of Okinawa. This species is also the only pine on the Tokara Islands north of Amami-Oshima according to Wilson (1920), but Hayashi (1952) reports that *Pinus thunbergiana* occurs as far south as Takara, one of the southernmost islands of this group (see map 34).

Sources:

Published—Wilson 1920.

Unpublished—F. R. Fosberg 1963; S. Hatusima 1962; E. H. Walker 1963.

***Pinus hwangshanensis* Hsia**

MAP 36

Hwangshan pine

Pinus hwangshanensis Hsia in Tsoong, Peiping
Nat. Acad. Inst. Bot. Contrib. 4: 155. 1936.

This pine has a discontinuous distribution in the higher mountains of eastern and central China, extending from Chekiang and Anhwei west to Hupeh and Kweichow and south to Fukien and Hunan. For many years this species was confused with *P. tabulaeformis* of northern and western China (e.g., Law 1947), although it appears to be much more closely related to *P. luchuensis*, the low-elevation pine of the Ryukyu Islands.

Source:

Published—Wu 1963.

***Pinus tabulaeformis* Carr.**

MAPS 37 AND 38

Chinese pine

Pinus tabulaeformis Carr., Traité Gen. Conif.
Ed. 2, 510. 1867.

This widespread and variable pine occupies a broad, discontinuous belt in China from southeastern Tibet and northern Yunnan to Inner Mongolia, southern Manchuria, and Shantung. It usually grows at moderate elevations, and is one of the characteristic trees of the isolated mountain ranges in the semiarid northwest of China. The common form of this species at high elevations in western Szechuan and northern Yunnan is *Pinus tabulaeformis* var. *densata* (Mast.) Rehd. Wu (1947; see Thesis below) has suggested that this variant may be a natural hybrid between *P. tabulaeformis* and *P. yunnanensis*, but it extends at least 100 miles north and northwest of the northern limits of *P. yunnanensis* (Cheng 1939, Ku and Cheo 1941).

Sources:

Published—Cheng 1939 (Szechuan); Chow 1947 (Kansu); Clark and Sowerby 1912 (Shansi); Cowdry 1922 (Hopeh); Fox 1949 (Inner Mongolia); Handel-Mazzetti 1927 and 1929-1936 (Yunnan, Szechuan); Hao 1938 (Kansu); Hers 1922

(Honan); Hu 1935 (Honan); Kabanov 1962; Ku and Cheo 1941 (Szechuan); Kung and Wang 1934 (Hopeh); Limpricht 1922; Liou 1931 (Hopeh); Liu 1928 (Hopeh); Marquand 1929 (Tibet); Orr 1933 (Yunnan); Rehder 1923; Rehder and Wilson 1929 (Kansu); Rock 1933 (Kansu); H. Smith 1925 (Shansi); Takahasi 1936 (Hopeh), 1944 (Liaoning); Tang 1931 (Shansi); Taylor 1947 (Tibet); Teng 1947 (Kansu); Walker 1941 (Kansu, Inner Mongolia); Wang 1961; Ward 1936b and 1941a (Tibet); Wilson 1913 (Szechuan); Wu 1956; Yang 1937 (Hopeh).

Thesis—Chung-Lwen Wu 1947. The phytogeographical distribution of pine in China. M.F. thesis, Yale Univ., 74 pp., illus.

Unpublished—Wang Chi-Wu 1964 (Hopeh).

***Pinus yunnanensis* Franch.**

MAP 37

Yunnan pine

Pinus yunnanensis Franch., Jour. de Bot. 13: 253. 1899.

This pine is confined to Yunnan, southern Szechuan, and the western parts of Kwangsi and Kweichow. It is closely allied to *Pinus insularis*, which grows at generally lower elevations to the south and west of *P. yunnanensis*, and to the variable *P. tabulaeformis* to the north.

Sources:

Published—Cheng 1939; Handel-Mazzetti 1927, 1929-1936; Hsu 1950; Ku and Cheo 1941; Rock 1947; Schweinfurth 1957; Teng 1940; Wang 1961; Ward 1924; Wilson 1926.

Unpublished—Wang Chi-Wu 1964.

***Pinus insularis* Endl.**

MAP 38

Khasi pine

(see also Map 37)

Pinus insularis Endl., Synops. Conif. 157. 1847.

This pine grows in most of the higher parts of southeast Asia, from the Khasi Hills of Assam, India, the valleys of Zayul in southeastern Tibet, and southwestern Yunnan, to the highlands of southern Vietnam and the mountains of northern Luzon in the Philippine Islands. Its distribution is incompletely known in many parts of southeastern Asia, especially the mountains of Laos and northern Vietnam. The limits of the species in China are uncertain because of its close similarity to *Pinus yunnanensis*. Wu (1956) considered the two a single species, but we have followed the usage of most of the botanists familiar with them in the field and treated them separately (Handel-Mazzetti 1929-1936; Wang 1961; Wilson 1926). Intermediates have been reported between this species and the allied *P. merkusii* in the Zambales region of Luzon (Perkins 1904).

Sources:

Published—Biswas 1933; Bor 1938 (Assam); Bui 1962 (Laos); Philippine Islands, Bureau of Forestry, 1935 (Luzon); Burkill 1924 (Burma, Yunnan); Chevalier 1919 (Vietnam); Credner 1935 (Thailand); Deb 1960 (Manipur); Ferrars 1875 (Burma); Fischer 1938 (Assam); Foxworthy 1911 (Luzon); Handel-Mazzetti 1929-1936 (Yunnan); Larsen 1962 (Thailand); J. G. F. Marshall 1901 (Thailand); Merrill 1922 (Luzon); Milton 1960 (Burma); Ogawa et al. 1961 (Thailand); Pendleton 1962 (Thailand); Rao and Panigrahi 1961 (Assam); Schweinfurth 1957 (Tibet); P. Singh 1913 (Burma); Suvatabandhu 1961 (Thailand); Teng 1948 (Yunnan); Troup 1921 (India, Burma); Vidal 1960 (Laos); Wang 1961 (Yunnan); Ward 1934 (Tibet), 1936a (Assam), 1941c (Burma), 1949 (Burma), 1952a (Manipur), 1959 (Burma); Whitford 1911 (Luzon); Wilson 1926 (Yunnan, Burma).

Unpublished—M. Schmid to N. T. Mirov 1961 (Vietnam); Silviculturist, Burma, 1963 (Burma); Wang Chi-Wu 1964 (Yunnan).

***Pinus merkusii* Jungh. & de Vriese** MAP 39
Merkus pine

Pinus merkusii Jungh. & de Vriese in de Vriese,
Pl. Nov. Ind. Bat. 5, t. 2. 1845.

Pinus merkusii ranges from eastern Burma, northern Laos, northern Vietnam, and the island of Hainan south to Cambodia, southern Vietnam, and the island of Sumatra, and east to Luzon and Mindoro in the Philippine Islands. This species is the only member of the genus that extends south of the Equator. It reaches its southern limit at about 2° S. latitude on Sumatra. The distribution of *P. merkusii* is still not completely known, especially on the Asian mainland. Its natural occurrence on the island of Hainan is questionable; Merrill (1927) indicates that it may have been planted there, but both Hosokawa (1940) and Wu (1956) show Hainan as part of the natural range of this species. *P. merkusii* grows at low elevations throughout its range, and in many areas is associated with and replaced elevationally by *P. insularis*. These two closely related species may hybridize on Luzon (see *P. insularis*).

Sources:

Published—Bui 1962; Philippine Islands, Bureau of Forestry, 1935 (Mindoro); Burkill 1924 (Burma, Thailand); Chevalier 1944 (Vietnam); Ferrars 1875 (Burma); Luytjes 1924 (Sumatra); Maurand 1943; Merrill 1927 (Hainan); Royal Forest Department, Thailand, 1962 (Thailand); Ryan and Kerr 1911 (Thailand); P. Singh 1913 (Burma); van Steenis 1958 (Sumatra); Suvatabandhu 1961 (Thailand); Vidal 1960 (Laos); Wilson 1926 (Burma, Thailand).

Unpublished—W. S. Astle to N. T. Mirov 1961 (Cambodia); N. T. Mirov 1961 (Luzon, Sumatra); M. Schmid to N. T. Mirov 1961 (Vietnam); Silviculturist, Burma, 1963 (Burma).

SUBSECT. AUSTRALES Loud.

***Pinus palustris* Mill.** MAP 40
longleaf pine

Pinus palustris Mill., Gard. Dict. Ed. 8,
Pinus No. 14. 1768.

Longleaf pine is limited to the Coastal Plain of southeastern United States from southeastern Virginia to central Florida and west to eastern Texas. It hybridizes in nature with at least two of its principal associates, *Pinus taeda* (Chapman 1922) and *P. elliotii* (Mergen 1958).

***Pinus taeda* L.** MAP 41
loblolly pine

Pinus taeda L., Sp. Pl. 1000. 1753.

Loblolly pine ranges through the Coastal Plain and Piedmont of eastern and southeastern United States from Delaware south to central Florida, west to eastern Texas, and north in the Mississippi Valley to southeastern Oklahoma, Arkansas, and southern Tennessee. It is associated with several related species, and is believed to hybridize in nature with at least four of them—*Pinus palustris* (Chapman 1922), *P. echinata* (Zobel 1953), *P. serotina* (Wenger 1958), and *P. rigida*⁶.

Additional source:

Published—Bethune 1963 (Fla.).

⁶ Committee on Southern Forest Tree Improvement Newsletter IV (1), May 1955. (Processed).

***Pinus echinata* Mill.** MAP 42
shortleaf pine

Pinus echinata Mill., Gard. Dict. Ed. 8,
Pinus No. 12. 1768

Shortleaf pine extends from Long Island, New York, and New Jersey to Pennsylvania, southern Ohio, southern Illinois, and southern Missouri, south to eastern Oklahoma and eastern Texas, and east to northern Florida and Georgia. The most widespread of the southern pines, this species occupies large areas of Coastal Plain, Piedmont, and mountains from the Appalachians to the Ozarks. It crosses naturally with at least two associated pines, *Pinus rigida* (Austin 1928) and *P. taeda* (Zobel 1953).

Additional sources:

Published—Aughanbaugh 1950 (Pa.); Haney 1955; Liming 1946 (Mo.); Perry 1924 (Pa.); Shafer and Chisman 1957 (Pa.).

***Pinus glabra* Walt.** MAP 43
spruce pine

Pinus glabra Walt., Fl. Carol. 237. 1788.

Spruce pine is confined to the Coastal Plain of southeastern United States from South Carolina to northern Florida and west to southeastern Louisiana. A minor constituent of the pine forests, it is associated with *Pinus taeda*, *P. elliotii*, and others.

***Pinus rigida* Mill.** MAP 44
pitch pine

Pinus rigida Mill., Gard. Dict. Ed. 8,
Pinus No. 10. 1768.

Pitch pine ranges from central Maine to New York, extreme southwestern Quebec, and extreme southeastern Ontario, south to Pennsylvania, Ohio, and Delaware, and south in mountains to eastern Tennessee, northern Georgia, and western South Carolina. From near sea level northward, this species extends southward into higher altitudes along the entire length of the Appalachian Mountains. It often grows on poor sites, and is the characteristic tree of the pine barrens of New Jersey.

It is associated with several related pines in the southern part of its range, and is thought to cross in nature with *Pinus echinata* (Austin 1928) and *P. taeda*⁷. Its closest relative, however, is *P. serotina*. These two very similar pines intergrade in Delaware⁷ and southern New Jersey (Clausen 1939), but it is uncertain whether this intergradation is due to hybridization or to incomplete divergence of the two.

Additional sources:

Published—Grandtner 1961 (Que.); Illick and Aughanbaugh 1930 (Pa.); Rouleau 1955 (Que.).

Unpublished—T. C. Brayshaw and A. E. Porsild 1964 (Canada).

***Pinus serotina* Michx.** MAP 44
pond pine

Pinus serotina Michx., Fl. Bor.-Amer. 2: 205. 1803.

Pond pine is restricted to the Coastal Plain of southeastern United States from southern New Jersey and Delaware south to central and northwestern Florida and central Alabama.

It is thought to cross naturally with one of its commonest associates, *Pinus taeda* (Wenger 1958). At the northern end of its range it overlaps and intergrades with *P. rigida* (see *P. rigida*).

⁷ Committee on Southern Forest Tree Improvement Newsletter IV (1), May 1955. (Processed).

Pinus Lamb.

MAP 43

Mountain pine

Pinus pungens Lamb., Ann. Bot. 2: 198. 1805.

Mountain pine is largely confined to the Appalachian mountains of eastern United States from eastern and northern Pennsylvania southwest to eastern Tennessee and western South Carolina, with outposts in Kentucky and northern Georgia. This species is remarkable among the pines of this series for its heavily armed cones.

***Pinus elliottii* Engelm.**

MAP 45

Slash pine

Pinus elliottii Engelm., Acad. Sci. St. Louis Trans. 4: 186, t. 1-3. 1880.

Slash pine is restricted to the Coastal Plain of southeastern United States from southern South Carolina to southern Florida, including the Florida Keys, and west to southeastern Louisiana. A major constituent of the lower Coastal Plain pine forests, slash pine has two geographical varieties, both mapped. South of the widespread typical variety, (var. *elliottii*), South Florida slash pine (*Pinus elliottii* var. *densa* Little & Dorman) extends through central and southern Florida to the Keys. This species is separated from the nearest stands of the closely related *P. caribaea*, on Grand Bahama Island, by about 70 miles.

Among the several related pines with which it is associated, slash pine is believed to hybridize naturally with *Pinus palustris* (Mergen 1958). Perry and Wang (1957) have speculated that *P. elliottii* var. *densa*, notable for the modified grass stage of its seedlings, may have originated through introgressive hybridization of these two species.

Additional sources:

Published—Little and Dorman 1954; Langdon 1963 (Fla.).

***Pinus caribaea* Morelet**

MAP 46

Caribbean pine

Pinus caribaea Morelet, Rev. Hort. Côte d'Or 1: 107. 1851.

Caribbean pine occurs on several of the Bahama Islands, in Pinar del Rio Province of western Cuba, on the Isle of Pines, and along the Caribbean seaboard of Central America from British Honduras to Nicaragua. As formerly interpreted, this species included slash pine of the southeastern United States, now considered distinct as *P. elliottii* (Little and Dorman 1954).

In its island distribution the only other pine with which Caribbean pine is associated is *Pinus tropicalis*—in western Cuba and on the Isle of Pines. In interior Honduras and Nicaragua, its range overlaps that of *P. oocarpa*. The inland form of *P. caribaea* in this region tends to resemble *P. oocarpa*, suggesting the possibility of natural hybridization (Denevan 1961, p. 276; L. Williams 1955).

The southernmost outlier of *Pinus caribaea* on the east coast of Nicaragua, near the town of Bluefields, is the most southerly locality reached by any pine in the Western Hemisphere.

The presence of *Pinus caribaea* in Quintana Roo, Mexico (Standley and Steyermark 1958), has not been verified and is not shown on the map.

Sources:

Published—Barrett and Golfari 1962; Denevan 1961 (Nicaragua); Directorate of Overseas Surveys 1958 (British Honduras); Helbig 1957 and 1959 (Honduras); Little and Dorman 1954 (Bahama Islands); Lundell 1961 (Guatemala); March 1949 (Bahama Islands); Marie-Victorin and Léon 1942 (Cuba); E. E. Smith 1954 (Cuba); Standley and Steyermark 1958 (Guatemala).

Thesis—Jeffrey Radley 1960. The physical geography of the east coast of Nicaragua. M.A. thesis, Univ. of Calif., Berkeley, Calif., 188 pp., illus.

Unpublished—C. L. Ludwig (undated map of Guatemala).

***Pinus occidentalis* Sw.**

MAP 46

West Indian pine

Pinus occidentalis Sw., Nov. Gen. Sp. Pl. 103. 1788.

This species is restricted to the island of Hispaniola, where it is the only pine, and the Sierra Maestra of eastern Cuba. It grows at a wide range of elevations, but is more common at high elevations.

Sources:

Published—Ciferri 1936 (Dominican Republic); Denevan 1961 (Haiti); E. E. Smith 1954 (Cuba); Street 1960 (Haiti).

***Pinus cubensis* Griseb.**

MAP 46

Cuban pine

Pinus cubensis Griseb., Amer. Acad. Mem., Ser. 2, 8: 530. 1862.

This low-elevation pine is limited to the eastern part of Oriente Province, Cuba. It may extend to the Sierra Maestra of this province, where the closely related *Pinus occidentalis* is widespread, but this extension has not been verified (E. E. Smith 1954) and is not shown on the map.

Source:

Published—E. E. Smith 1954.

SUBSECT. *PONDEROSAE* Loud.

***Pinus ponderosa* Laws.**

MAP 47

Ponderosa pine

Pinus ponderosa Laws., Agr. Man. 354. 1836.

Ponderosa pine, including its variants *Pinus ponderosa* var. *scopulorum* Engelm. and *P. ponderosa* var. *arizonica* (Engelm.) Shaw (*P. arizonica* Engelm.), extends from southern British Columbia east to southwestern North Dakota and central Nebraska, and south to southern California, northern Durango, and San Luis Potosí. Within this enormous range this variable yellow pine is unexplainably absent from a large area that includes southern Idaho, western Wyoming, southwestern Montana, and part of the Great Basin. In California ponderosa pine extends south almost to the Mexican border but has not been found in northern Baja California (Duffield and Cumming 1949).

In the Sierra Madre Occidental of northwestern Mexico, *Pinus ponderosa* var. *arizonica* grows with other yellow pines (*P. engelmannii*, *P. durangensis*) which link the *P. ponderosa* complex to the group of yellow pines concentrated in central Mexico (*P. montezumae*, *P. pseudostrobus*, and others). In California ponderosa pine is associated with *P. jeffreyi* at upper elevations, and the two hybridize in nature (Haller 1962). Ponderosa pine may also intergrade with *P. washoeensis* (Haller 1961).

Our map is based primarily upon a detailed map of the species prepared by R. Z. Callaham.

Additional sources:

Published—Ayres 1900a and 1900b (Mont.); Bailey and Bailey 1941; Costello and Schwan 1946 (Colo.); Deaver and Haskell 1955 (Ariz.); Haller 1962 (Calif.); Johnston 1943 (Coah.); Leiberger 1900b (Oreg.), 1904a (Mont.); J. T. Marshall 1957 (Son., Chih.); Merriam 1893 (Nev.); Potter and Green 1964 (N. Dak.); Rogers 1953; G. C. Rzedowski 1960 (S.L.P.); J. Rzedowski 1956 (S.L.P.); Sudworth 1900a and 1900b (Colo.); Townsend 1895 (N. Mex.); Zobel and Cech 1957 (N.L.).

Unpublished—W. D. Billings 1961 (Nev.); T. C. Brayshaw and A. E. Porsild 1964 (B.C.); W. P. Cottam 1964 (Utah); J. D. Curtis 1964 (Utah); J. F. Franklin 1964 (Oreg.); J. R. Haller 1964 (Calif.); F. D. Johnson 1964 (Idaho); F. Kramer to N. T. Mirov (n.d.) (Nev.); O. V. Matthews 1964 (Oreg.); R. A. Read 1964; R. Schmidt 1964 (B.C.); W. I. Stein 1964; R. F. Wagle 1962 (Ariz.); O. Zarzosa L. 1964 (Dgo.).

***Pinus washoensis* Mason & Stockwell** MAP 48
Washoe pine

Pinus washoensis Mason & Stockwell, Madroño
8: 62. 1945.

Not distinguished until 1945, Washoe pine is known only from limited areas in three mountain ranges at the western edge of the Great Basin in Nevada and California. It occupies a few square miles on the east slopes of Mt. Rose, Nev., and has recently been discovered in the southern Warner Mountains of northeastern California (Haller 1961) and on the Bald Mountain Range (Calif.), about 20 miles northwest of Mt. Rose (Critchfield and Allenbaugh 1965). In all three localities it grows at higher elevations than *Pinus ponderosa*, its closest relative. According to Haller, it may also be occasional in a variable population of *P. ponderosa* and *P. jeffreyi* near Hobart Mills, Calif., about 14 miles west of Mt. Rose.

Sources:

Published—Critchfield and Allenbaugh 1965; Haller 1961; Mason and Stockwell 1945.

***Pinus jeffreyi* Grev. & Balf.** MAP 48
Jeffrey pine

Pinus jeffreyi Grev. & Balf. in A. Murr., Bot.
Exped. Oreg. [Rpt. No. 8] 2, t. 1853.

Primarily a California species, Jeffrey pine extends into southwestern Oregon, western Nevada, and northern Baja California. It usually grows at higher elevations than the closely related *Pinus ponderosa*, but the two overlap broadly and hybridize in nature (Haller 1962). Our map is based on a distribution map prepared by D. F. Roy and modified from the sources of information listed below.

Additional sources:

Published—Haller 1962.

Thesis—Donald V. Hemphill 1952. The vertebrate fauna of the boreal areas of the southern Yolla Bolly Mountains, California. Ph.D. thesis, Oregon State College, 340 pp., illus.

Unpublished—B. K. Ford 1963 (Calif.); J. R. Griffin 1964 (Calif.); D. V. Hemphill 1964 (Calif.); J. L. Jenkinson 1963 (Calif., Oreg.); Reid Moran 1964 (Baja Calif.).

***Pinus engelmannii* Carr.** MAP 49
Apache pine

Pinus engelmannii Carr., Rev. Hort., Sér. 4,
3: 227. 1854; "engelmanni."

Apache pine extends from southeastern Arizona and extreme southwestern New Mexico through the Sierra Madre Occidental of Mexico to Zacatecas and Aguascalientes.

This species has also been known as *Pinus latifolia* Sarg., *P. apachea* Lemm., and *P. macrophylla* Engelm. It usually grows at lower elevations than the related yellow pines of this region (*P. ponderosa*, *P. durangensis*, *P. cooperi*).

Additional sources:

Published—Gentry 1946 (Sin.); Guzmán and Vela 1960 (Zac., Ags.); J. T. Marshall 1957 (Son., Chih.).

Thesis—James H. Maysilles 1959. Floral relationships of the pine forests of western Durango, Mexico. Ph.D. thesis, Univ. Michigan, 165 pp., illus.

Unpublished—O. Zarzosa L. 1964 (Dgo.); C. E. Blanco 1964 (Dgo.).

***Pinus durangensis* Martínez**

MAP 50

Durango pine

Pinus durangensis Martínez, Mex. Inst. Biol. An.

13: 23, fig. 1-4. 1942

This species is confined to Mexico, ranging from eastern Sonora to southern Durango, with outliers in Michoacán and Nuevo León. It is an important constituent of the yellow pine forests in the Sierra Madre Occidental.

Additional sources:

Published—J. T. Marshall 1957 (Son.); Wicht 1949 (Chih.); Zobel and Cech 1957 (N.L.).

Thesis—James H. Maysilles 1959. Floral relationships of the pine forests of western Durango, Mexico. Ph.D. thesis, Univ. Michigan, 165 pp., illus.

Unpublished—Mexico, Instituto Nacional de Investigaciones Forestales 1964 (Ags.); N. Sánchez Mejorada to L. W. Bryan 1963 (Mich.); O. Zarzosa L. 1964 (Dgo.).

***Pinus cooperi* C. E. Blanco**

MAP 51

Cooper pine

Pinus cooperi C. E. Blanco, Mex. Inst. Biol. An.

20: 185, fig. 1. 1949.

This species grows at moderate elevations in the extensive pine forests of southern Chihuahua and western Durango. It is associated with several other species in the western yellow pine group, including *Pinus ponderosa* (*P. arizonica* Engelm.), *P. engelmannii*, and *P. durangensis*. *P. cooperi* was originally named *P. lutea* C. E. Blanco (not Walt.).

Additional sources:

Unpublished—C. E. Blanco 1964 (Dgo.); O. Zarzosa L. 1964 (Dgo.); E. Hernandez X. and J. Vasquez Soto 1964 (Chih.).

***Pinus montezumae* Lamb.**

MAP 49

Montezuma pine

Pinus montezumae Lamb., Descr. Genus Pinus. Ed.

3 (8°), 1: 39, t. 22. 1832.

This variable species is a major constituent of the pine forests of central Mexico, ranging from Jalisco to Veracruz and south to Oaxaca, Chiapas, and Guatemala. It is also present in the Sierra Madre Oriental, and its northernmost known occurrence is in an outlier of this range, the Sierra Picachos in Nuevo León (Zobel and Cech 1957). In various parts of its range it is associated with many of the other Mexican yellow pines, and it may intergrade with some of them (Loock 1950, p. 180).

Additional sources:

Published—Aguilar 1961 (Guatemala); Goldman 1951; Hernandez X. et al. 1951 (Tamps.); Leavenworth 1946 (Mich.); Loock 1950 (Mich.); Schwerdtfeger 1953 (Guatemala); Zobel and Cech 1957 (N.L.).

Unpublished—B. Hallberg 1964 (Oax.); E. Larsen 1962; F. Medellín-Leal 1964 (S.L.P.); N. Sánchez Mejorada to L. W. Bryan 1963 (Mich.).

***Pinus hartwegii* Lindl.**

MAP 51

Hartweg pine

Pinus hartwegii Lindl., Bot. Reg. v. 25, Misc. 62. 1839.

Pinus hartwegii, including the doubtfully distinct *P. rudis* Endl., has a markedly discontinuous distribution at high elevations from Chihuahua and Nuevo León south to Guatemala and El Salvador. It often reaches timberline, but at lower elevations it overlaps and may intergrade with *P. montezumae* (Standley and Steyermark 1958).

Additional sources:

Published—Aguilar 1961 (Guatemala); Hinds and Larsen 1961 (Mex.); Leavenworth 1946 (Mich.); Loock 1950

—Miranda 1957 (Chis.); Schwerdtfeger 1953 (Guatemala); Shaw 1909 (Chih.); Sociedad Botánica de México 1960 (Ver.); Douglas and Steyermark 1958 (Guatemala); Zobel 1954 (N. L.).
 Published—P. H. Allen 1962 (El Salvador); B. Hallberg 1964 (Oax.); Mexico, Instituto Nacional de Investigaciones Forestales 1964 (Gro.); E. Larsen 1962; R. McVaugh 1964 (Oax.).

***Pinus michoacana* Martínez**

MAP 50

Michoacán pine

Pinus michoacana Martínez, Mex. Inst. Biol. An. 15: 1, fig. 1-4, 1944.

This pine grows at relatively low elevations in central and southern Mexico, from southern Durango and San Luis Potosí southeast to Chiapas. It is sometimes associated with its close relative, *Pinus montezumae*.

Additional sources:

Published—Guzmán and Vela 1960 (Zac.); Loock 1950 (Mich.).

Unpublished—L. W. Bryan 1964 (Oax.); B. Hallberg 1964 (Oax., Chis.); E. Larsen 1962 (Mich., Dgo.); N. Sánchez Mejorada to L. W. Bryan 1963 (Mich.).

***Pinus pseudostrobus* Lindl.**

MAP 52

Pinus pseudostrobus Lindl., Bot. Reg. v. 25, Misc. 63. 1839.

Pinus pseudostrobus, including the doubtfully distinct *P. tenuifolia* Benth. (not Salisb.) and *P. oaxacana* Mirov, is widespread at moderately high elevations from Sinaloa and Nuevo León through central and southern Mexico, and in Central America as far south as northwestern Nicaragua. This variable species complex extends farther south than any other western yellow pine. In the western part of its range it overlaps the closely related *P. douglasiana*.

Additional sources:

Published—Aguilar 1961 (Guatemala); Allen 1955 (Honduras); Castaños 1962 (Oax.); Denevan 1961 (Nicaragua); Gentry 1946 (Sin.); Goldman 1951 (Mich.); Leavenworth 1946 (Mich.); Loock 1950 (Mich.); Miranda 1961 (Chis.); Miranda and Sharp 1950 (Pue.); Pfeifer 1960 (Honduras); Shaw 1909; Sociedad Botánica de México 1960 (Ver.); Vogel 1954 (Honduras); Wicht 1949 (Mich.); Zobel and Cech 1957 (N. L.).

Unpublished—P. H. Allen 1962 (El Salvador); B. Hallberg 1964 (Oax.); N. Sánchez Mejorada to L. W. Bryan 1963 (Mich.).

***Pinus douglasiana* Martínez**

MAP 52

Douglas pine

Pinus douglasiana Martínez, Madroño 7: 4, t.l. 1943.

This rather uncommon pine is widely scattered at middle elevations in western Mexico from extreme southern Sonora to Michoacán and México. Its range slightly overlaps that of its closest relative, the highly variable *Pinus pseudostrobus*.

Additional sources:

Unpublished—B. Hallberg 1964 (Oax.); C. E. Blanco 1964 (Dgo.).

***Pinus teocote* Schiede & Deppe**

MAP 53

Pinus teocote Schiede & Deppe in Schlecht. & Cham., Linnaea 5: 76. 1830.

Pinus teocote, including the weakly segregated *P. herrerae* Martínez, is one of the most widely distributed Mexican pines, ranging from Chihuahua and Coahuila south to Chiapas, and just entering western Guatemala. In southern Mexico it overlaps *P. lawsonii*, a related species.

Additional sources:

Published—Aguilar 1961 (Guatemala); Matuda 1950 (Chis.); J. Rzedowski 1956 (S.L.P.); G. C. Rzedowski 1960 (S.L.P.); Shaw 1909 (S.L.P.); Wicht 1949 (Mich.); L. Williams 1939 (Oax.).

Thesis—James H. Maysilles 1959. Floral relationships of the pine forests of western Durango, Mexico. Ph.D. thesis, Univ. Michigan, 165 pp., illus.

Unpublished—C. E. Blanco 1964 (Coah.); B. Hallberg 1964 (Oax.); F. Medellín-Leal 1964 (S.L.P.); O. Zarzosa L. 1964 (Dgo.).

***Pinus lawsonii* Roetzl**

MAP 53

Lawson pine

Pinus lawsonii Roetzl ex Gord., Pinet. Sup. 64. 1862.

This pine is confined to southern Mexico from Jalisco to Veracruz and south to Oaxaca. Its range overlaps that of the related *Pinus teocote*.

Additional sources:

Published—Loock 1950 (Mich.).

Unpublished—B. Hallberg 1964 (Oax.); N. Sánchez Mejorada to L. W. Bryan 1963 (Mich.).

SUBSECT. SABINIANAE Loud.

***Pinus sabiniana* Dougl.**

MAP 54

Digger pine

Pinus sabiniana Dougl. ex D. Don in Lamb., Descr.

Genus Pinus. Ed. 3 (8°), v. 2, unnumbered p.

between p. 144 and p. 145, t. 80. 1832;

Dougl., Linn. Soc. London Trans. 16: 749. 1833.

Digger pine is confined to California. It is characteristic of the dry foothills of the Sierra Nevada and the Coast Range. Sources:

Published—Griffin 1964.

Unpublished—J. R. Griffin 1964.

***Pinus coulteri* D. Don**

MAP 55

Coulter pine

Pinus coulteri D. Don, Linn. Soc. London Trans. 17: 440. 1836.

Coulter pine is restricted to the coastal mountains of central and southern California and northern Baja California. It overlaps two related species, *Pinus jeffreyi* and *P. sabiniana*, and is known to hybridize in nature with *P. jeffreyi* (Zobel 1951). The distribution of the species in California is based entirely on Vegetation-Type survey information. The sources listed below all pertain to Baja California.

Additional sources:

Published—Goldman 1916; Martínez 1948.

Unpublished—Reid Moran 1961; E. L. Sleeper 1964.

***Pinus torreyana* Parry**

MAP 55

Torrey pine

Pinus torreyana Parry ex Carr., Traité Gen. Conif. 326. 1855.

Torrey pine has a very restricted range in southern California. On the mainland it is confined to the low coastal bluffs flanking the Soledad Valley north of San Diego. Elsewhere it occurs only as a small grove on Santa Rosa Island. The mainland distribution shown on the map is based on Vegetation-Type mapping done in 1931; the present range of the species may be slightly less than that shown.

Additional source:

Unpublished—E. R. Blakley 1961 (Santa Rosa Island).

SUBSECT. *CONTORTAE* Little & Critchfield

Pinus banksiana Lamb. jack pine

MAP 56

Pinus banksiana Lamb., Descr. Genus Pinus
1: 7, t. 3. 1803.

Primarily a Canadian species, jack pine extends from north of 65° N. latitude along the Mackenzie River in western Canada south and east to the Lake States, northern New York and New England, and the Maritime Provinces of Canada. In Alberta, where this species overlaps the closely related *Pinus contorta*, natural hybridization is common (Moss 1949, Mirov 1956).

Additional sources:

Published—Baldwin 1961 (N.H.); Bentley and Smith 1960 (N.S.); Rudolf and Schoenike 1963 (U.S.); Rudolph, Libby, and Pauley 1957 (Minn.); Schoenike 1962 (Minn.).

Thesis—Roland E. Schoenike 1962. Natural variation in jack pine (*Pinus banksiana* Lambert). Ph.D. thesis, Univ. Minn., 232 pp., illus.

Unpublished—T. C. Brayshaw and A. E. Porsild 1964 (Canada); E. W. Littlefield 1952 (N.Y.).

Pinus contorta Dougl. lodgepole pine

MAP 56

Pinus contorta Dougl. ex Loud., Arb. Frut. Brit.
4: 2292, fig. 2210-2211. 1838.

One of the most widespread of the American pines, lodgepole pine extends from central Yukon in western Canada south to southern Colorado and northern Baja California. Within these limits lodgepole pine grows at a wider range of elevations than any other pine. Common just above sea level along the Pacific coast, it reaches about 11,000 feet in the southern Sierra Nevada and Rocky Mountains. The morphological diversity of this wide-ranging species has been investigated by Critchfield (1957).

The known range of lodgepole pine in western Canada has only recently been extended to the Mackenzie District, where it has been found in the Liard Mountains and elsewhere in the southwestern part of the district (Jeffrey 1959; T. C. Brayshaw and A. E. Porsild, personal communication, 1964). Another outlier, in the Birch Mountains of northeastern Alberta, was also discovered recently (A. H. Marsh, personal communication, 1964).

The only close relative of lodgepole pine in western North America is *Pinus banksiana*. The two overlap and hybridize in Alberta (see *P. banksiana*), and introgression into lodgepole pine is likely (Mirov 1956; Critchfield 1957).

Additional sources:

Published—Jeffrey 1959 (Canada); Leiberg 1900b (Oreg.).

Unpublished—T. C. Brayshaw and A. E. Porsild 1964 (Canada); J. F. Franklin 1964 (Oreg., Wash.); J. L. Jenkinson 1963 (Calif., Oreg.); F. D. Johnson 1964 (Idaho); A. H. Marsh 1963 (Alta.); O. V. Matthews 1964 (Oreg.); C. O. Stone 1964 (Calif.).

Subsect. *Pinus* subgen. *Pinus* sect. *Pinus* subsect. *Contortae* Little & Critchfield, subsect. nov. Folia 2 in fasciculo, breviter (2-9 cm. longae), hypodermide biforae, ductis resiniferis maxime ex parte medialibus. Ramuli verni multinodales. Strobili parvi (3-8 cm. longae), symmetricales vel obliqui, plerumque clausi vel scrotini aperti, longe persistentes, squamae plerumque cum aculeo persistente. Holotypus: *Pinus contorta* Dougl. ex. Loud., Arb. Frut. Brit. 4: 2292, fig. 2210-2211. 1838.

Pinus virginiana Mill.

MAP 57

Virginia pine

(see also Map 56)

Pinus virginiana Mill., Gard. Dict. Ed. 8

Pinus No. 9. 1768

Virginia pine is widespread in and near the Appalachian Mountains and the Piedmont region east of the Appalachians, ranging from Long Island, New York, south and east to central Alabama, western Tennessee, and southern Indiana and Ohio. It is separated from the closely related *Pinus clausa* by a 100-mile gap and from *P. banksiana* about 200 miles.

Additional source:

Published—Ross 1951 (Ind.).

Pinus clausa (Chapm.) Vasey sand pine

MAP 57

(see also Map 56)

Pinus clausa (Chapm. ex Engelm.) Vasey ex Sarg.,

U. S. Census, 10th, 1880, v. 9 (Rpt. Forests

No. Amer.): 199. 1884.

Sand pine grows on the sandy plains of Florida, just extending into the southern tip of Alabama. It is separated from the southernmost outliers of its closest relative, *Pinus virginiana*, by about 100 miles.

Additional source:

Published—R. W. Cooper 1957.

SUBSECT. *OOCARPAE* Little & Critchfield

Pinus radiata D. Don Monterey pine

MAP 58

Pinus radiata D. Don, Linn. Soc. London Trans.
17: 442. 1836.

The most widely planted of the pines, Monterey pine is restricted in nature to three coastal localities in central California. A related form, *Pinus radiata* var. *binata* Lemm., grows on Guadalupe Island, more than 150 miles from the coast of Baja California and nearly 500 miles from the nearest mainland population of *P. radiata*. Unlike mainland *P. radiata*, the island form grows at moderate elevations (1,300-4,000 feet according to Reid Moran, personal communication, 1961). On the mainland, *P. radiata* occurs with *P. attenuata* and *P. muricata* and is reported to hybridize occasionally with both (Stebbins 1950, p. 209-210).

Additional source:

Unpublished—Reid Moran 1961 (Guadalupe Island).

Pinus attenuata Lemm. knobcone pine

MAP 58

Pinus attenuata Lemm., Mining and Sci. Press
64: 45. 1892.

Knobcone pine, remarkable for its universally closed cones, is distributed patchily at low and middle elevations in the mountains of California and southwestern Oregon, with a single known locality in northern Baja California. It overlaps the closely related coastal species, *Pinus radiata*, at place in central California, and occasional natural hybrids have been observed in this locality (Stebbins 1950, p. 209).

Subsect. *Pinus* subgen. *Pinus* sect. *Pinus* subsect. *Oocarpae* Little & Critchfield, subsect. nov. Folia plerumque 3 (2-5) in fasciculo, hypodermide plerumque biforae, ductis resiniferis maxime ex parte medialibus. Ramuli verni multinodales vel uninodales. Strobili plerumque obliqui, clausi, longe persistentes, squamae cum aculeo vel protuberantes. Holotypus: *Pinus oocarpa* Schiede in Schlecht., Linnaea 12: 491. 1838.

sources:

—Howitt and Howell 1964 (Calif.).

—Gene B. Newcomb 1962. Geographic variation of *Pinus patula* Lemm. Ph. D. thesis, Univ. Calif., Berkeley. 191 pp., illus.

—Published—B. K. Ford 1963 (Oreg.); J. F. Franklin 1963 (Oreg.); J. R. Griffin 1963, 1964 (Calif.); J. L. Jenkins 1963 (Oreg.); O. V. Matthews 1964 (Oreg.); R. B. Vasey 1963 (Oreg.).

***Pinus muricata* D. Don**

MAP 59

bishop pine

Pinus muricata D. Don, Linn. Soc. London Trans. 17: 441. 1836.

Included here are *Pinus remorata* Mason and *P. muricata* var. *cedrosensis* Howell, although the status of the latter pine in particular is uncertain (Fielding 1961). Bishop pine, an extremely variable species complex, occurs in seven rather widely separated localities on the coast of California and northern Baja California, and on three islands situated 15 to 30 miles offshore. Its distribution may overlap that of the closely related *P. attenuata* near the coast of Mendocino County, Calif., and the two species grow less than 10 miles apart in the vicinity of San Luis Obispo, Calif. On the Monterey peninsula near Monterey, Calif., *P. muricata* is associated with *P. radiata*, and natural hybrids have been observed (Stebbins 1950, p. 209). A reported occurrence of *P. muricata* near Crescent City, Calif., based on a single tree found in the coastal forest, is not shown on the map (Mason 1949; H. L. Mason, personal communication, 1964).

Additional sources:

Published—Epling and Robison 1940 (Baja Calif.); Howell 1949 (Calif.); Mason 1949 (Calif.); W. Metcalf 1921 (Calif.); Muller 1962 (Baja Calif.).

Theses—John W. Duffield 1951. Interrelationships of the California closed-cone pines with special reference to *Pinus muricata* D. Don. Ph.D. thesis, Univ. Calif., Berkeley, Calif., 77 pp., illus.; George O. Hale 1941. A survey of the vegetation of Cedros Island, Mexico. M.A. thesis, Univ. Calif., Los Angeles, Calif., 96 pp., illus.

Unpublished—E. R. Blakley 1961 (Santa Cruz and Santa Rosa Islands); W. J. Libby 1964 (Cedros Island); P. Zinke 1961 (Calif.).

***Pinus patula* Schiede & Deppe**

MAP 60

Mexican weeping pine

Pinus patula Schiede & Deppe in Schlecht. & Cham., Linnaea 6: 354. 1831.

Pinus patula is restricted to eastern Mexico from Tamaulipas to Oaxaca. Its presence in Tamaulipas was reported only recently (Hernandez X. et al. 1951).

A variant in Chiapas referred tentatively to var. *longipedunculata* Loock may be identical with *P. oocarpa* var. *ochoterenai* Martínez (E. L. Little, Jr., 17957, 10 km. S. E. of San Cristobal de Las Casas; B. Hallberg, personal communication, 1964). The range of the Chiapas highlands pine is shown separately on Map 61.

Additional sources:

Published—Hernandez X. et al. 1951 (Tamps.); Wicht 1949 (Hgo.).

Unpublished—B. Hallberg 1964 (Oax., Chis.).

***Pinus greggii* Engelm.**

MAP 60

Gregg pine

Pinus greggii Engelm. ex Parl. in DC., Prodr. 16 (2): 396. 1868.

This uncommon species is confined to eastern and north-eastern Mexico from southeastern Coahuila to Hidalgo. Its range overlaps that of the closely related *Pinus patula* in eastern Hidalgo.

Additional sources:

Published—Johnston 1943 (Coah.).

Unpublished—J. W. Andresen 1964 (N.L.); E. Larsen (Hgo.); F. Medellin-Leal 1964 (S.L.P.).

***Pinus oocarpa* Schiede**

MAP 61

Pinus oocarpa Schiede in Schlecht., Linnaea 12: 491. 1838.

One of the most widespread Latin American pines, *Pinus oocarpa* ranges in Mexico from Sonora southeast to Hidalgo and Chiapas, and in Central America east and south to British Honduras and northwestern Nicaragua. It grows at relatively low elevations, and extends farther south than any other American pine except *P. caribaea*. *P. oocarpa* var. *ochoterenai* Martínez is shown separately because of its uncertain status (see *P. patula*).

Pinus tecumumani of Guatemala, which was proposed without a Latin diagnosis by Schwerdtfeger (1953), is considered by Standley and Steyermark (1958) a variant of *P. oocarpa*, and is not shown separately on the map.

Additional sources:

Published—Denevan 1961 (Nicaragua); Gentry 1946 (Sin.); Goldman 1951; Hunt 1962 (British Honduras); Lauer 1959 (Honduras); Loock 1950 (Mich.); Miranda 1961 (Chis.); Schwerdtfeger 1953 (Guatemala); Shaw 1909; Standley and Steyermark 1958 (Guatemala); Vogel 1954 (Honduras); Wagner 1962 (Chis.).

Thesis—Carl L. Johannessen 1959. The geography of the savannas of interior Honduras. Ph.D. thesis, Univ. Calif., Berkeley, Calif., 283 pp., illus.

Unpublished—C. E. Blanco 1964 (Dgo.); B. Hallberg 1964 (Oax., Chis.); E. Larsen 1962; N. Sánchez Mejorada to L. W. Bryan 1963 (Mich.); M. D. Moore 1963 (El Salvador); O. Zarzosa L. 1964 (Dgo.).

***Pinus pringlei* Shaw**

MAP 61

Pringle pine

Pinus pringlei Shaw in Sarg., Trees and Shrubs 1: 211, t. 100. 1905.

This distinctive low-elevation pine is confined to southern Mexico, ranging from Michoacán to Puebla and Oaxaca. It is sometimes associated with the related *Pinus oocarpa*.

Additional sources:

Published—Shaw 1909; Loock 1950 (Mich.).

Unpublished—Hallberg 1964 (Oax.); Larsen 1962 (Mex.).

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Distribution of



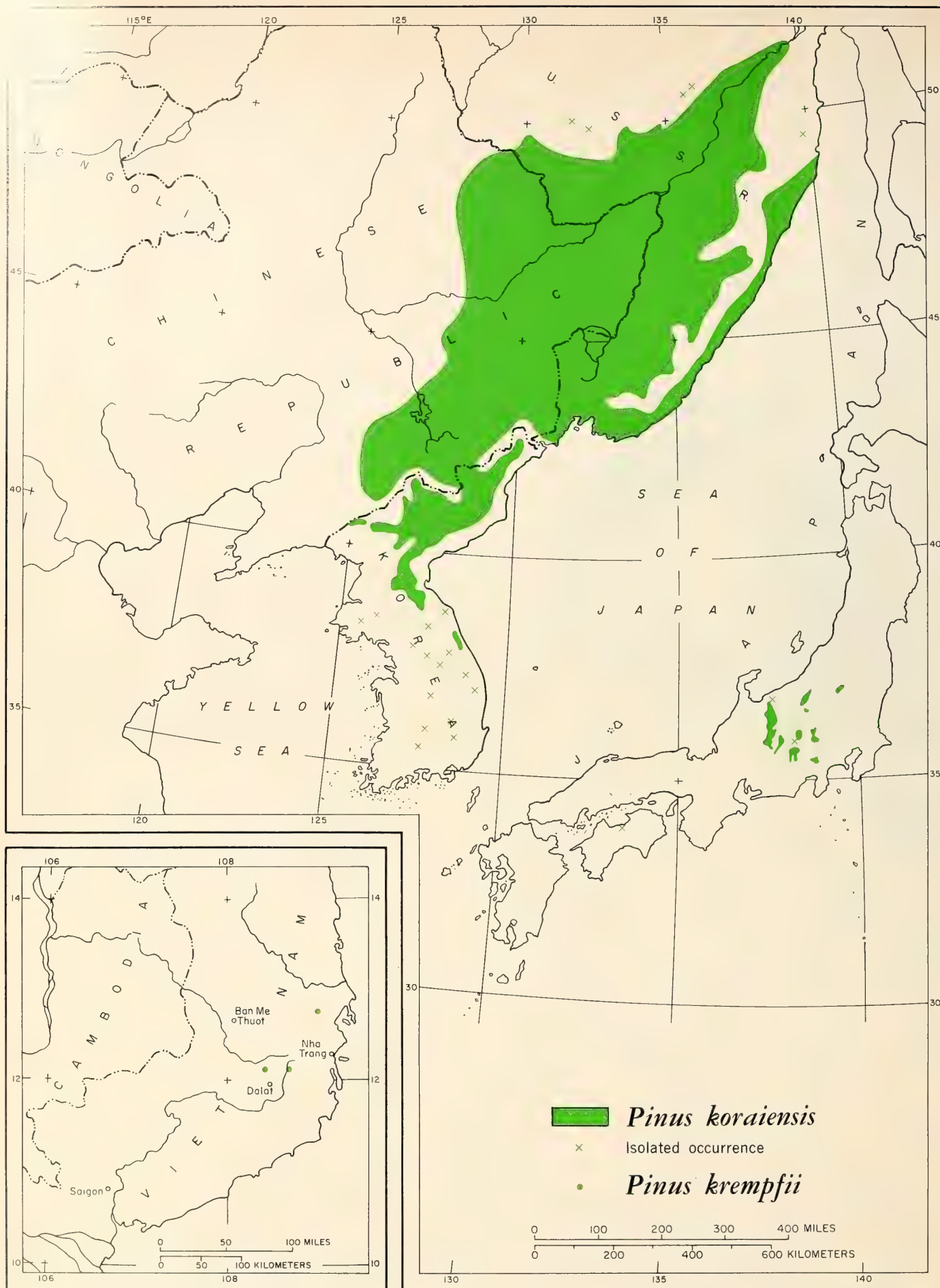
the Genus *Pinus*

Map 1



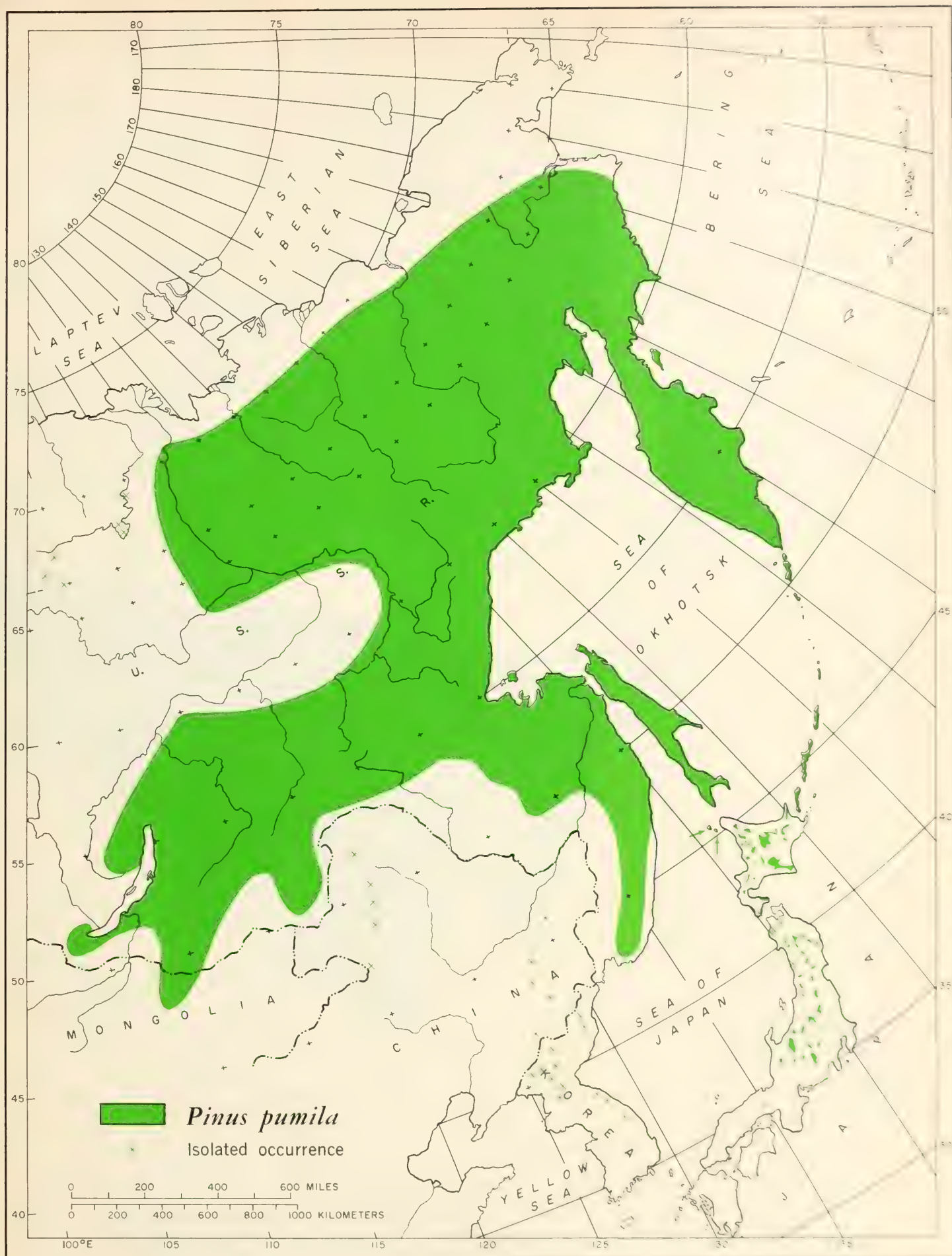


Distribution of the Genus Pinus



Map 2a

Map 2b



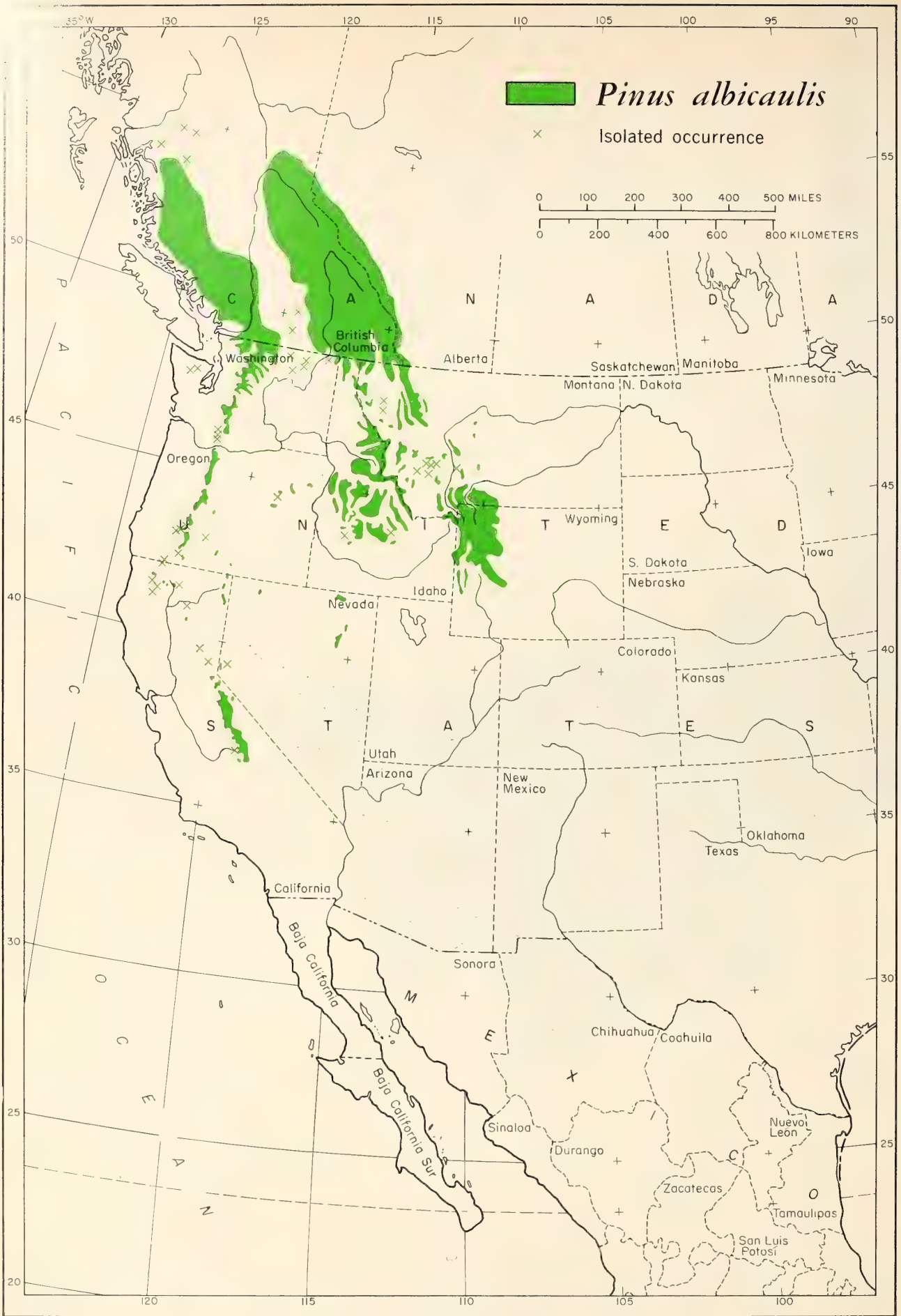
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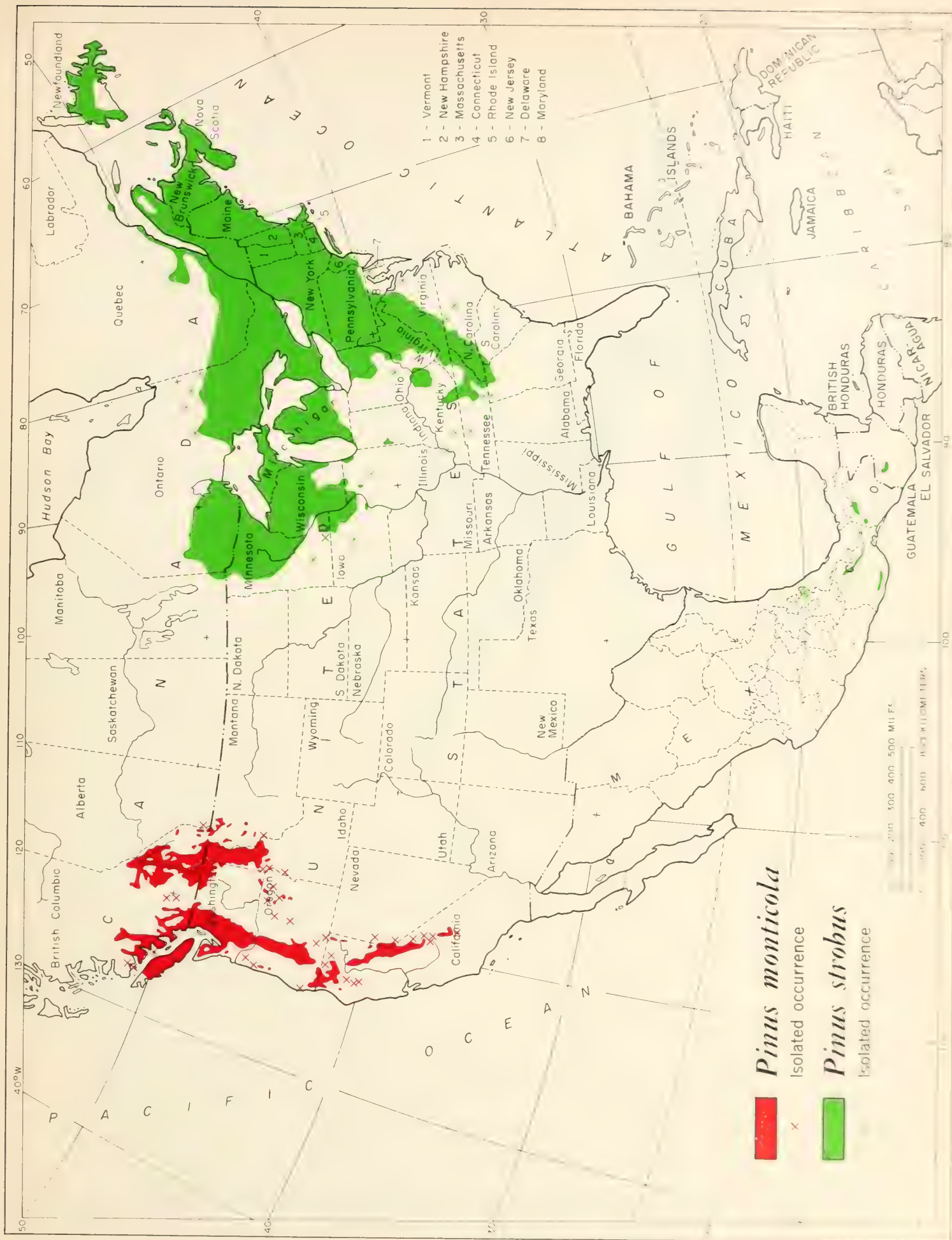
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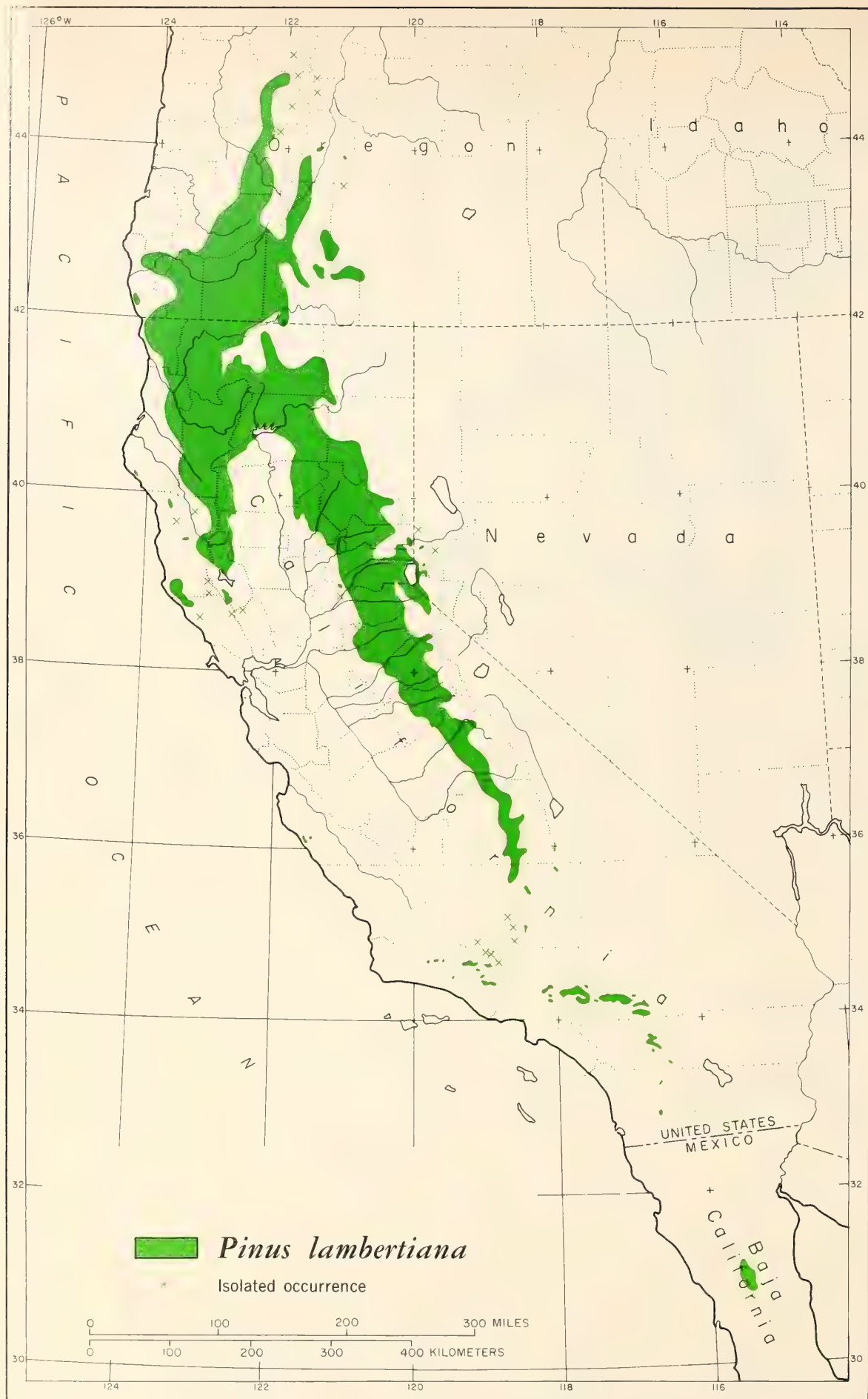


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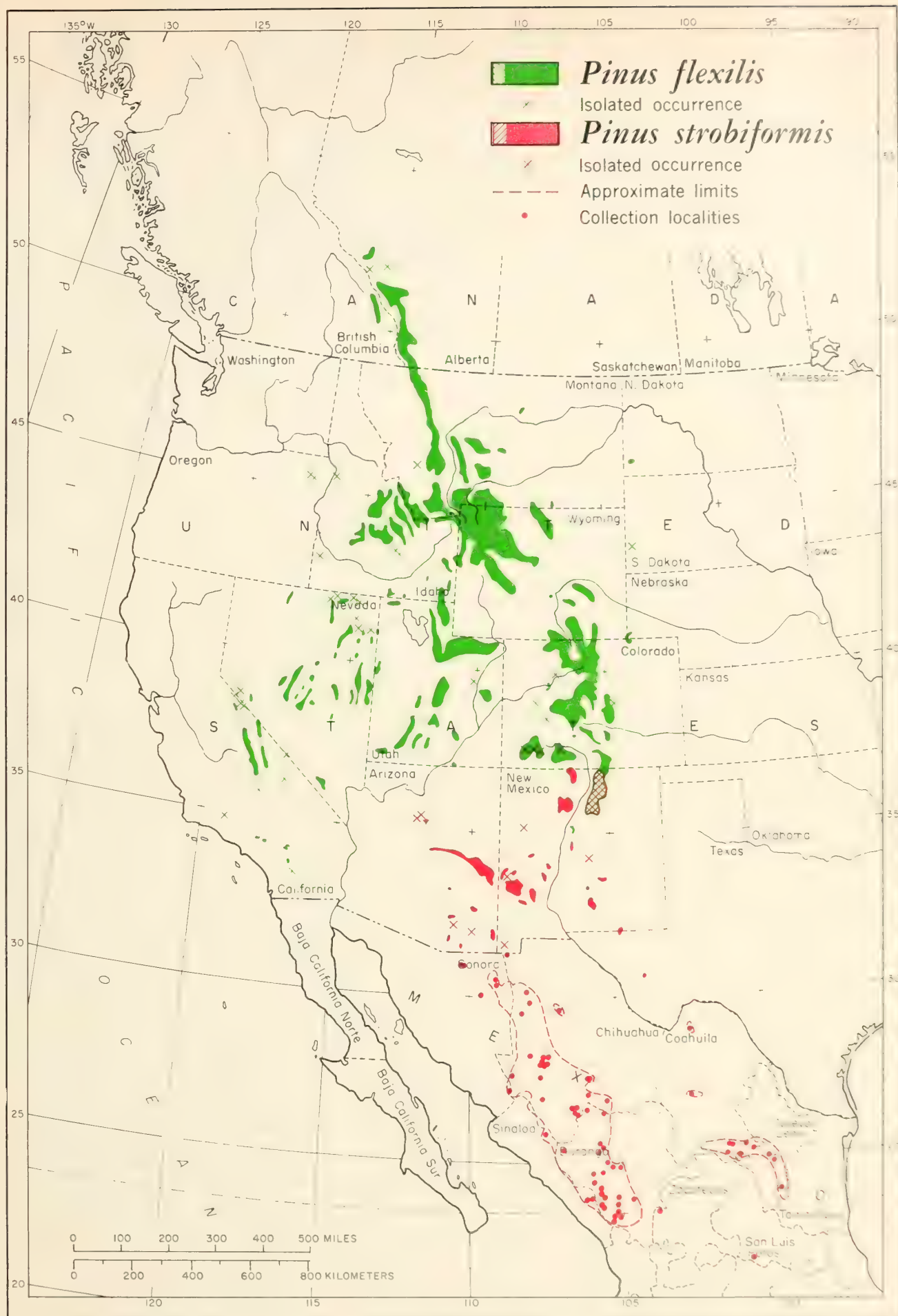


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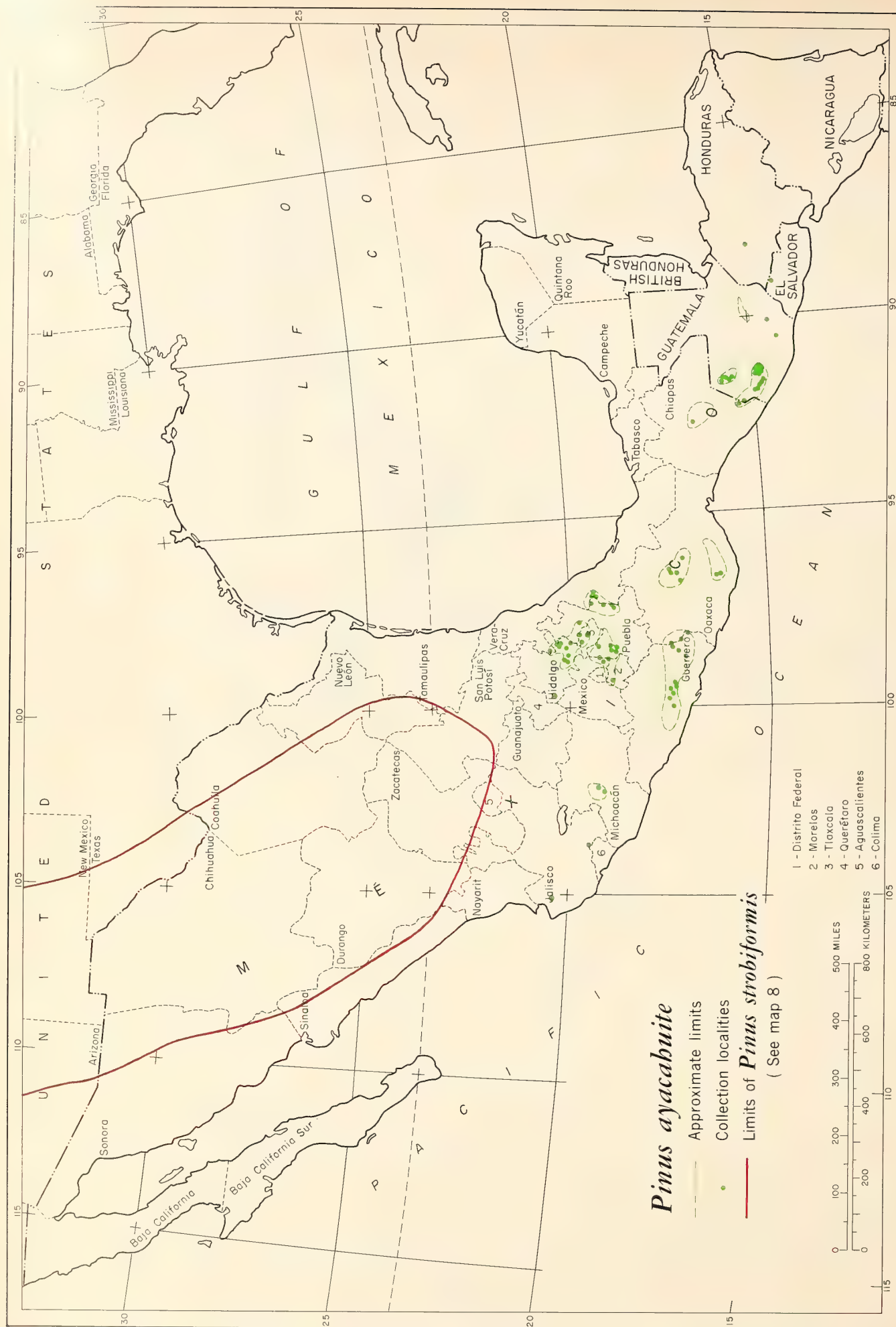


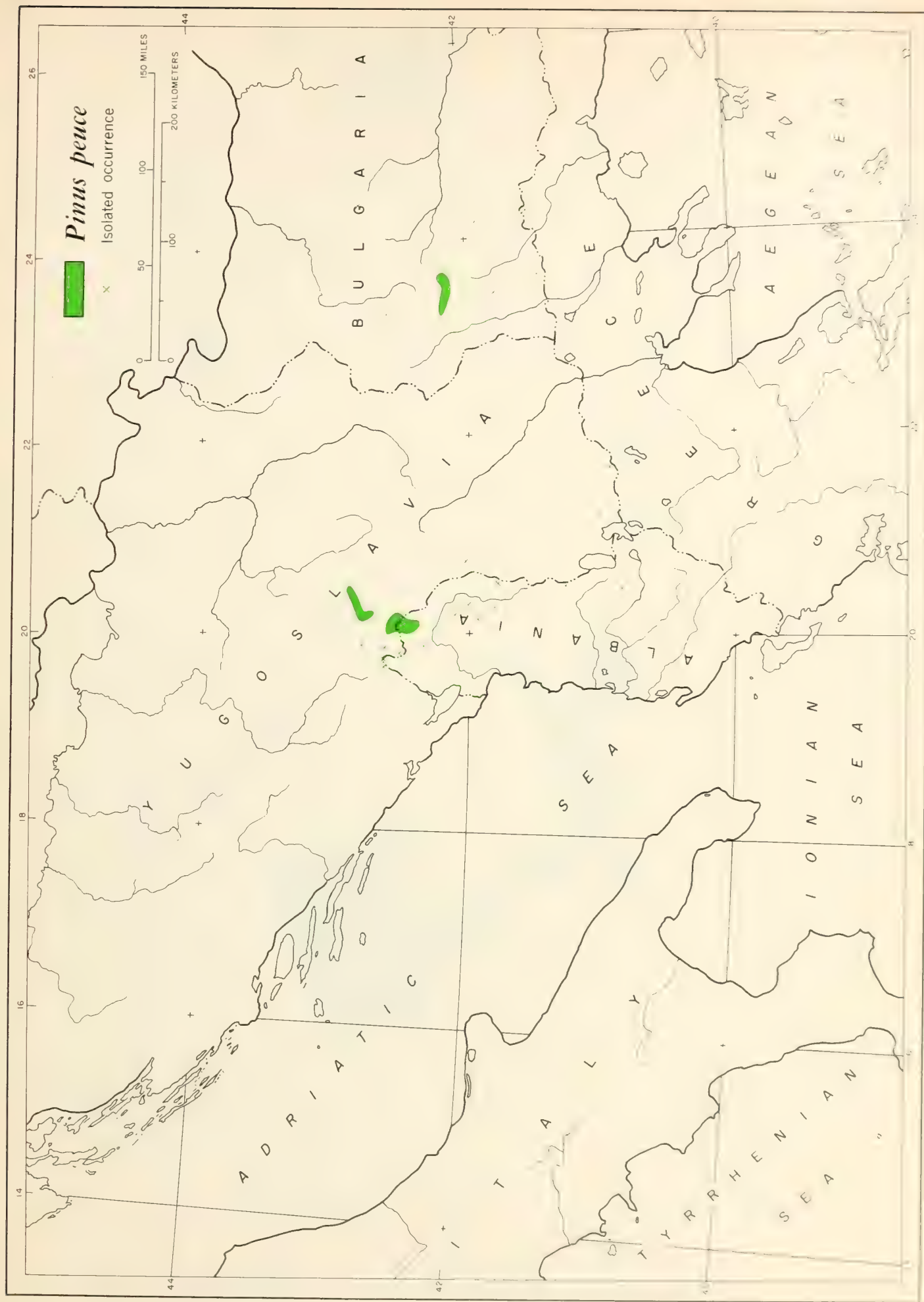


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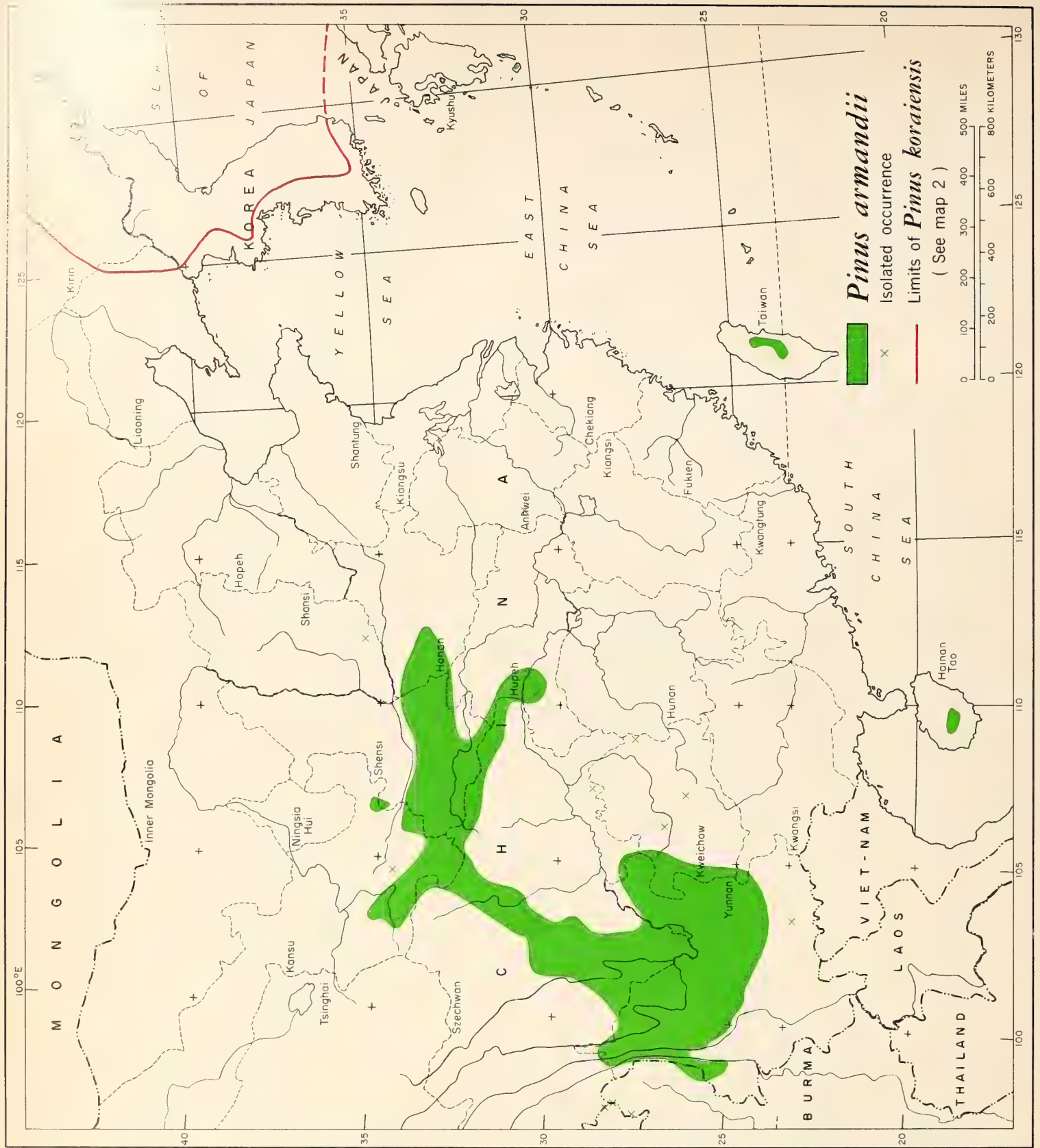


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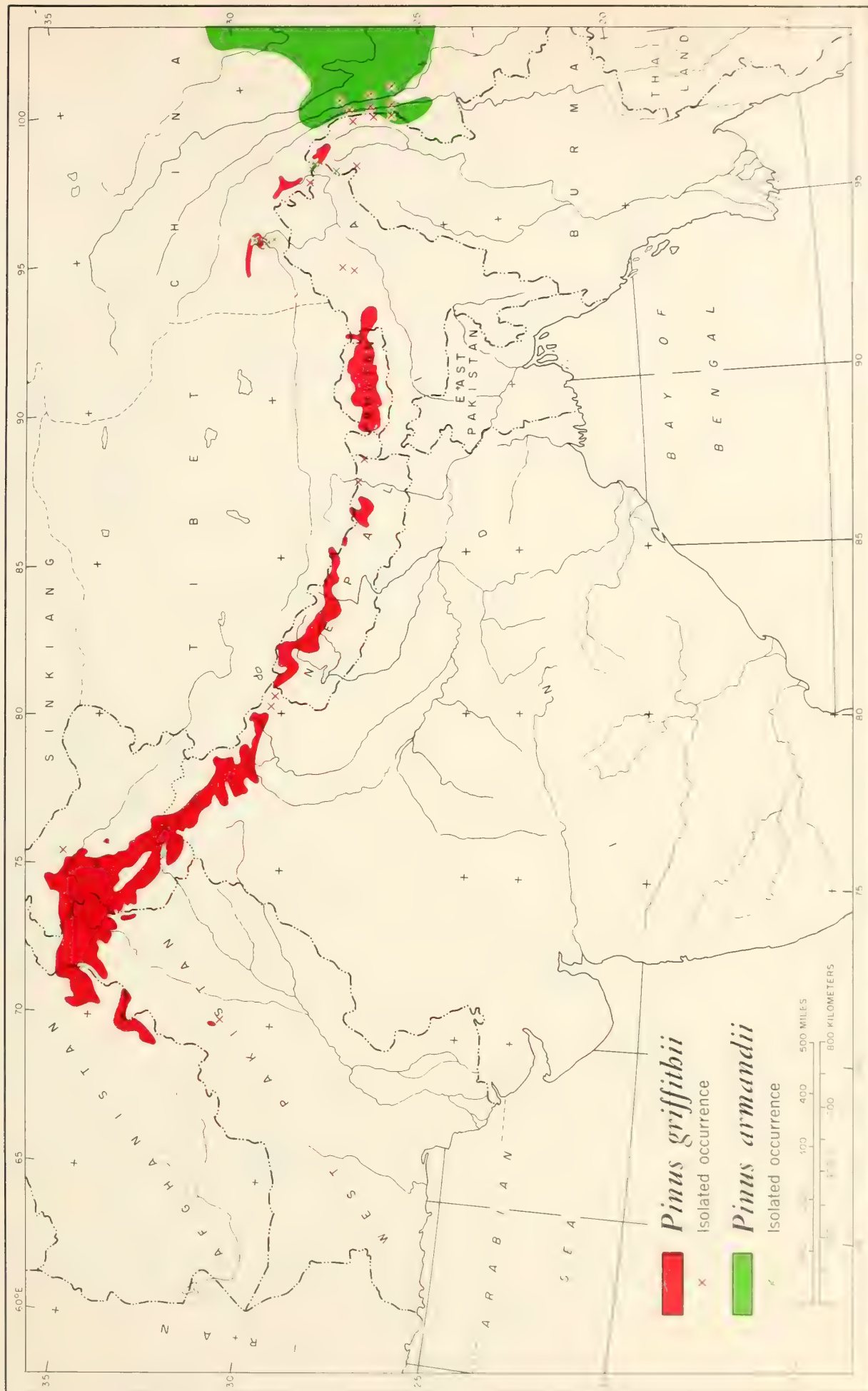




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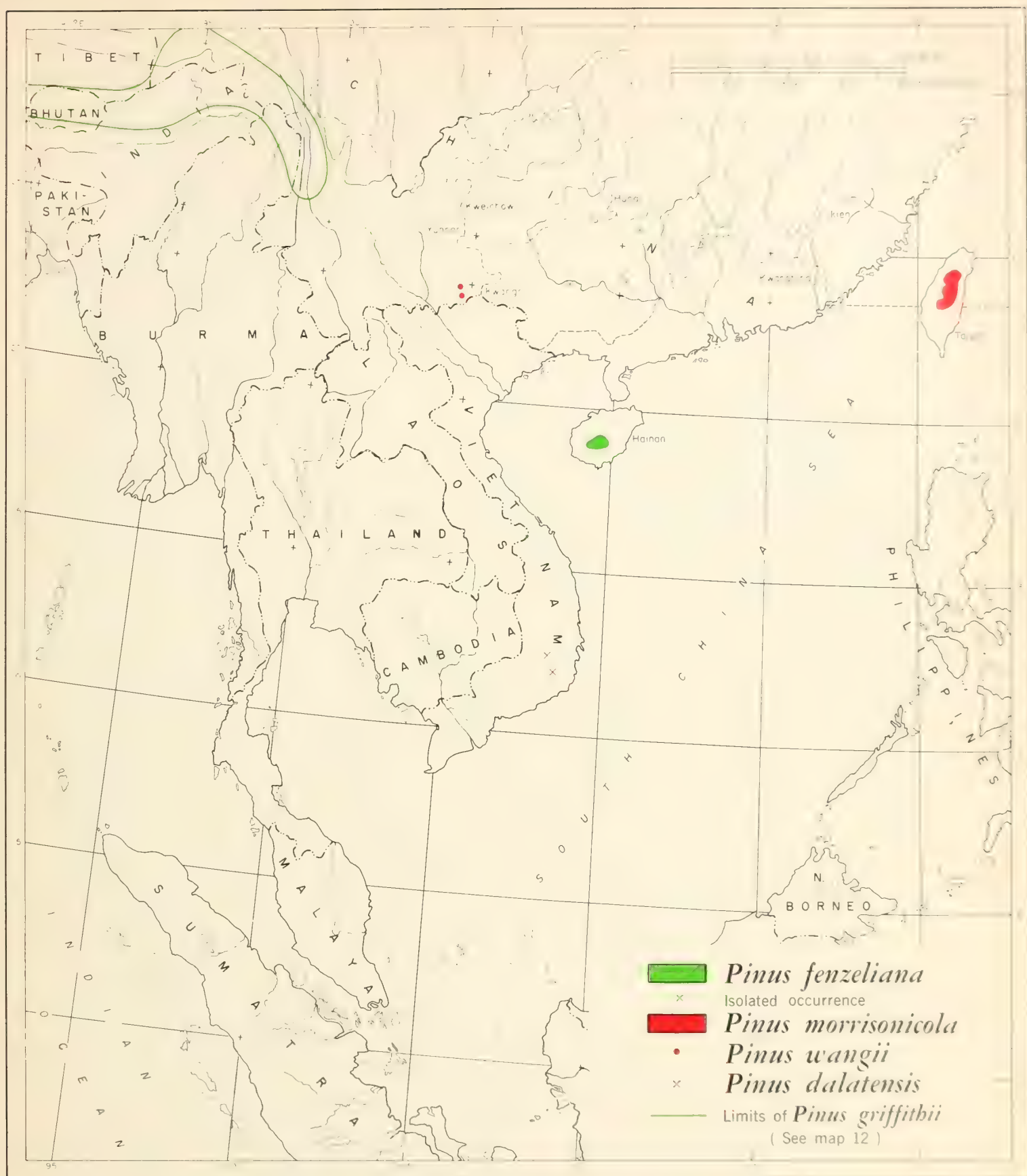
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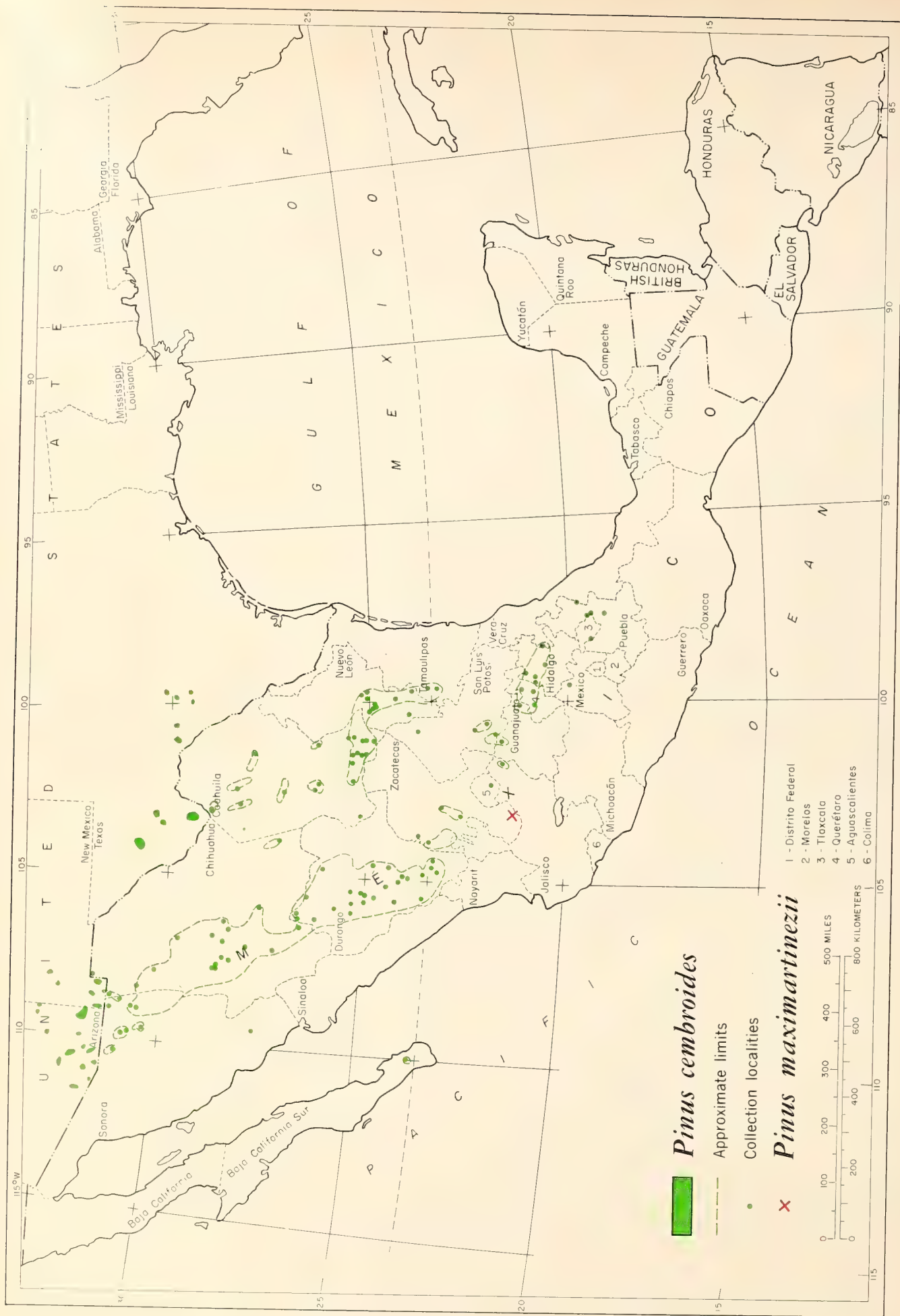
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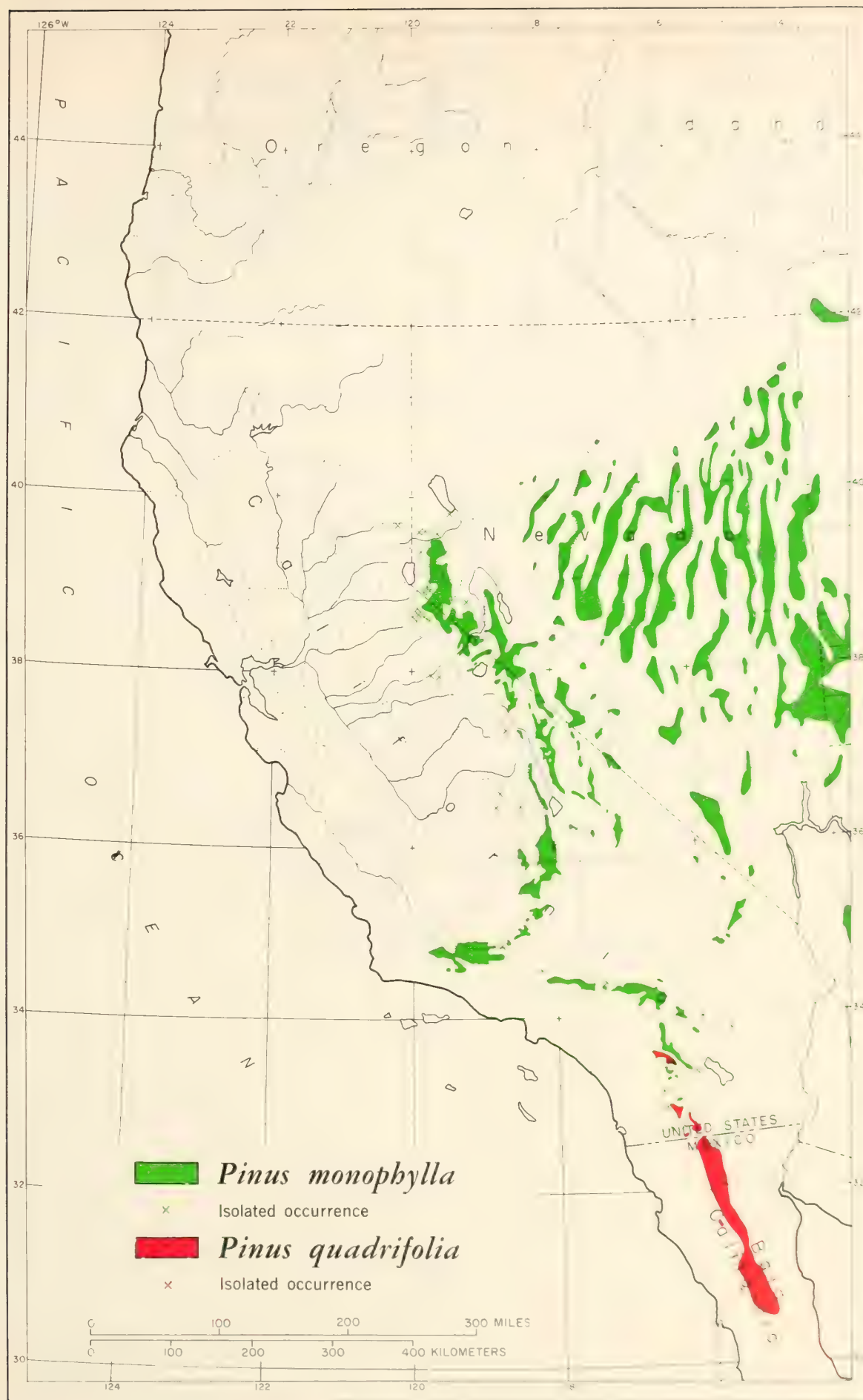


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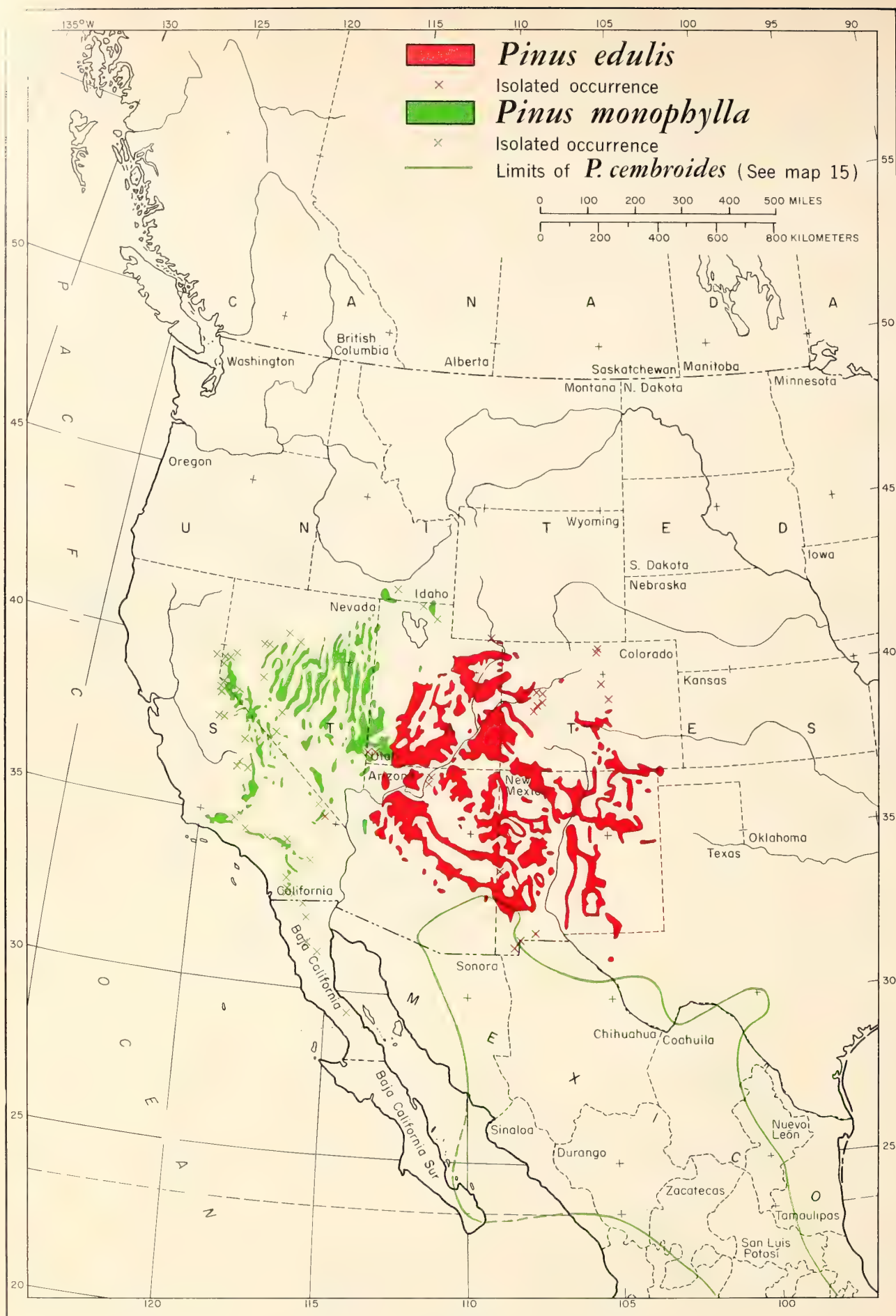


Map 14

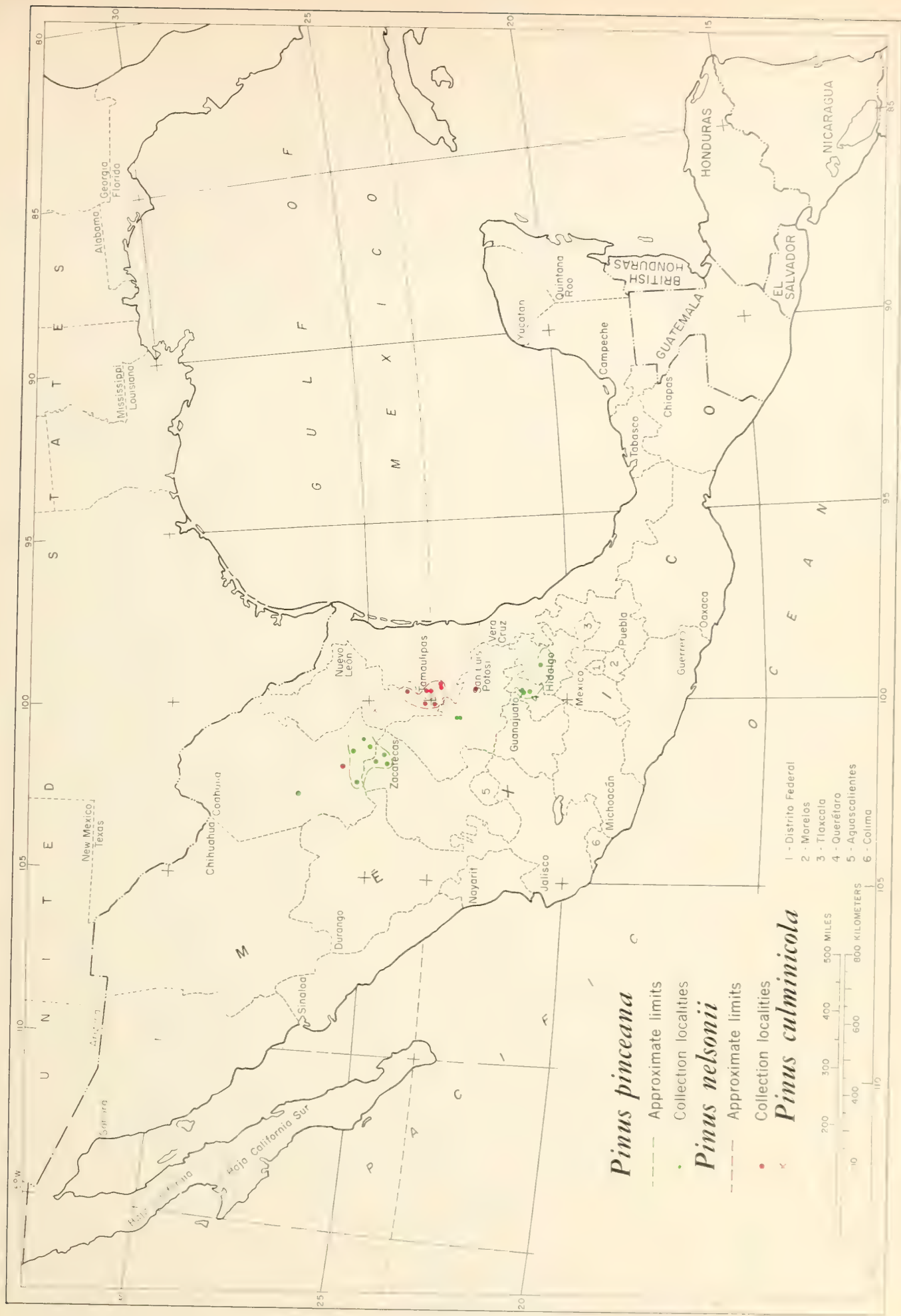




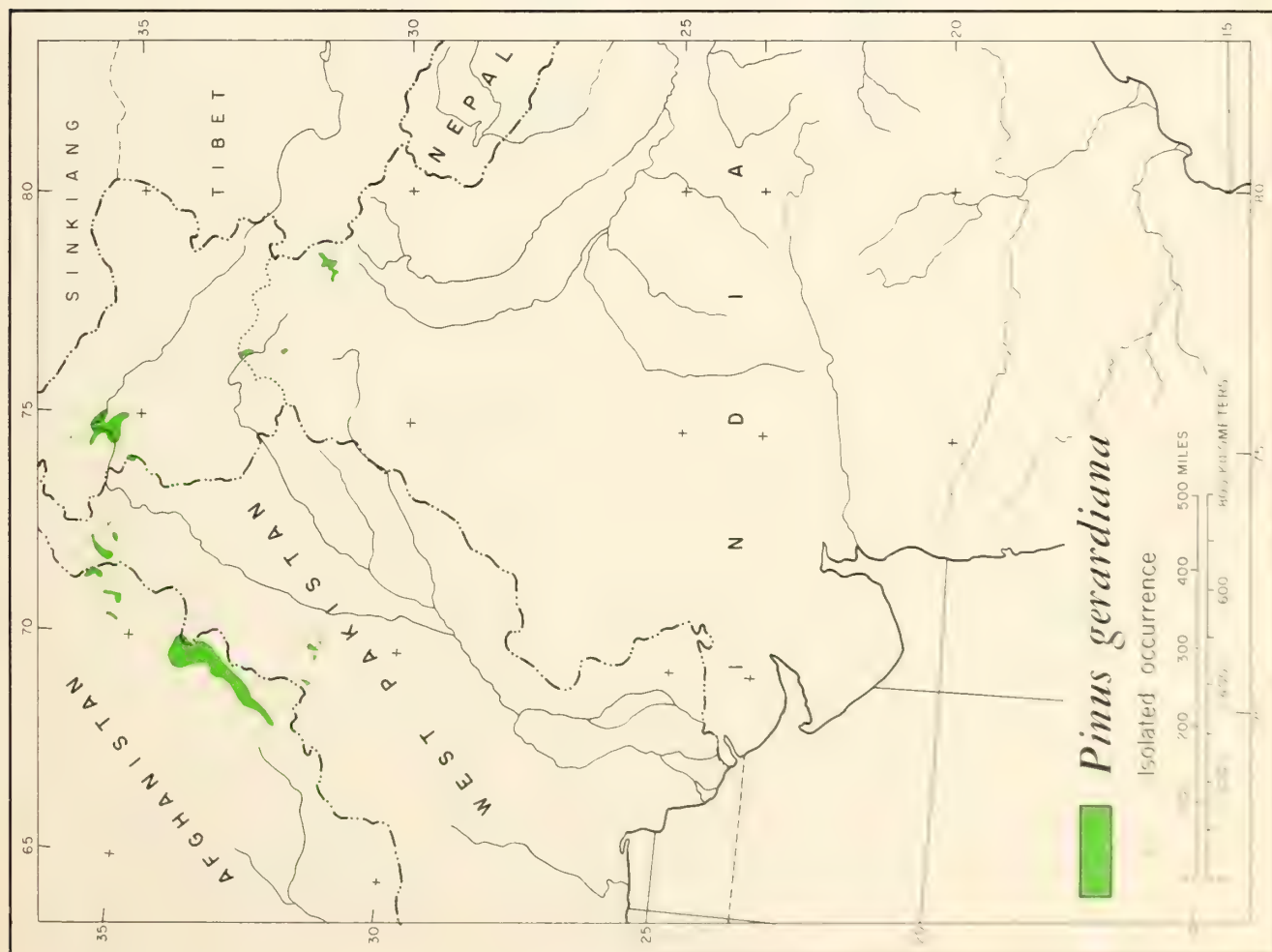
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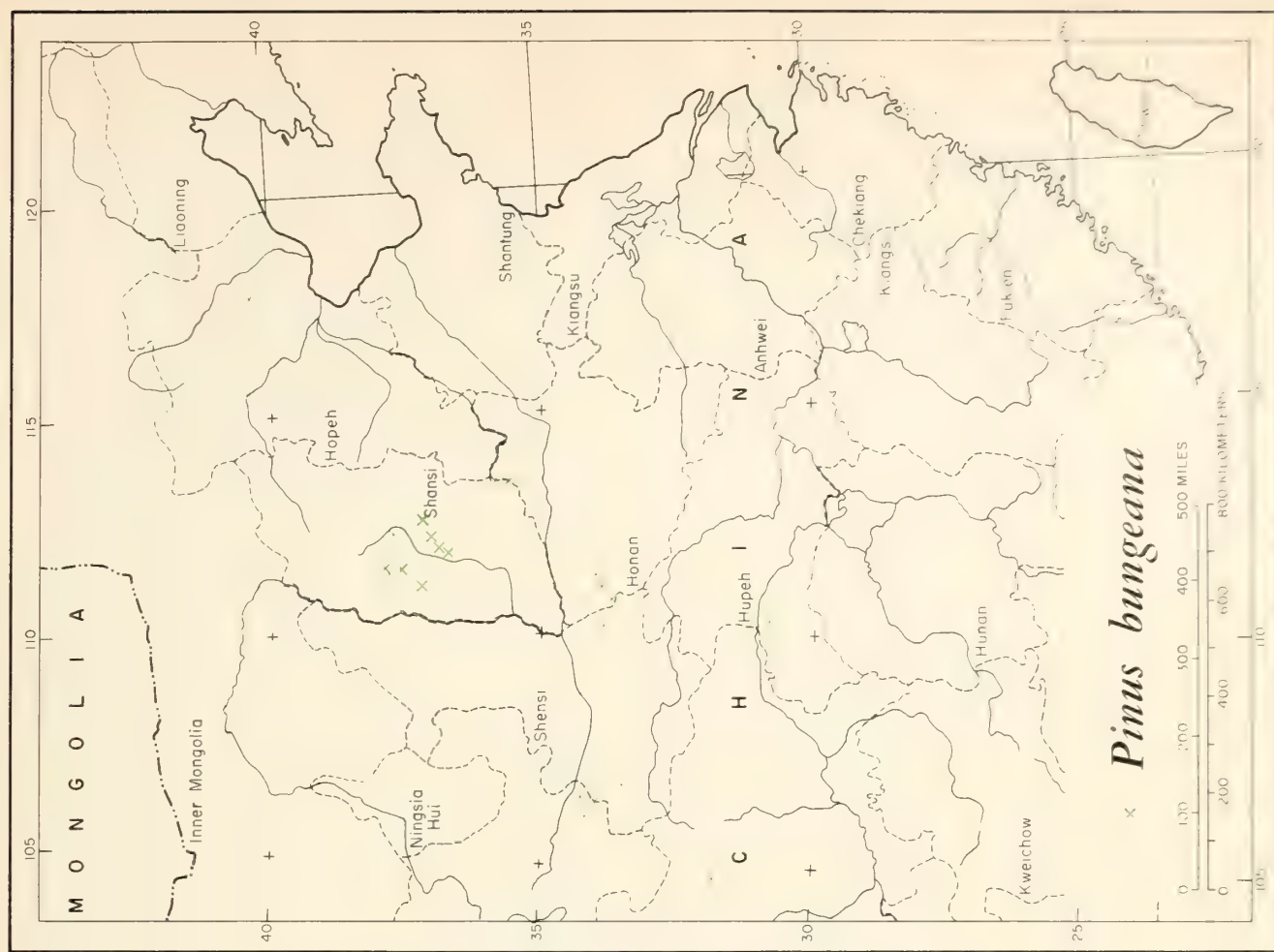
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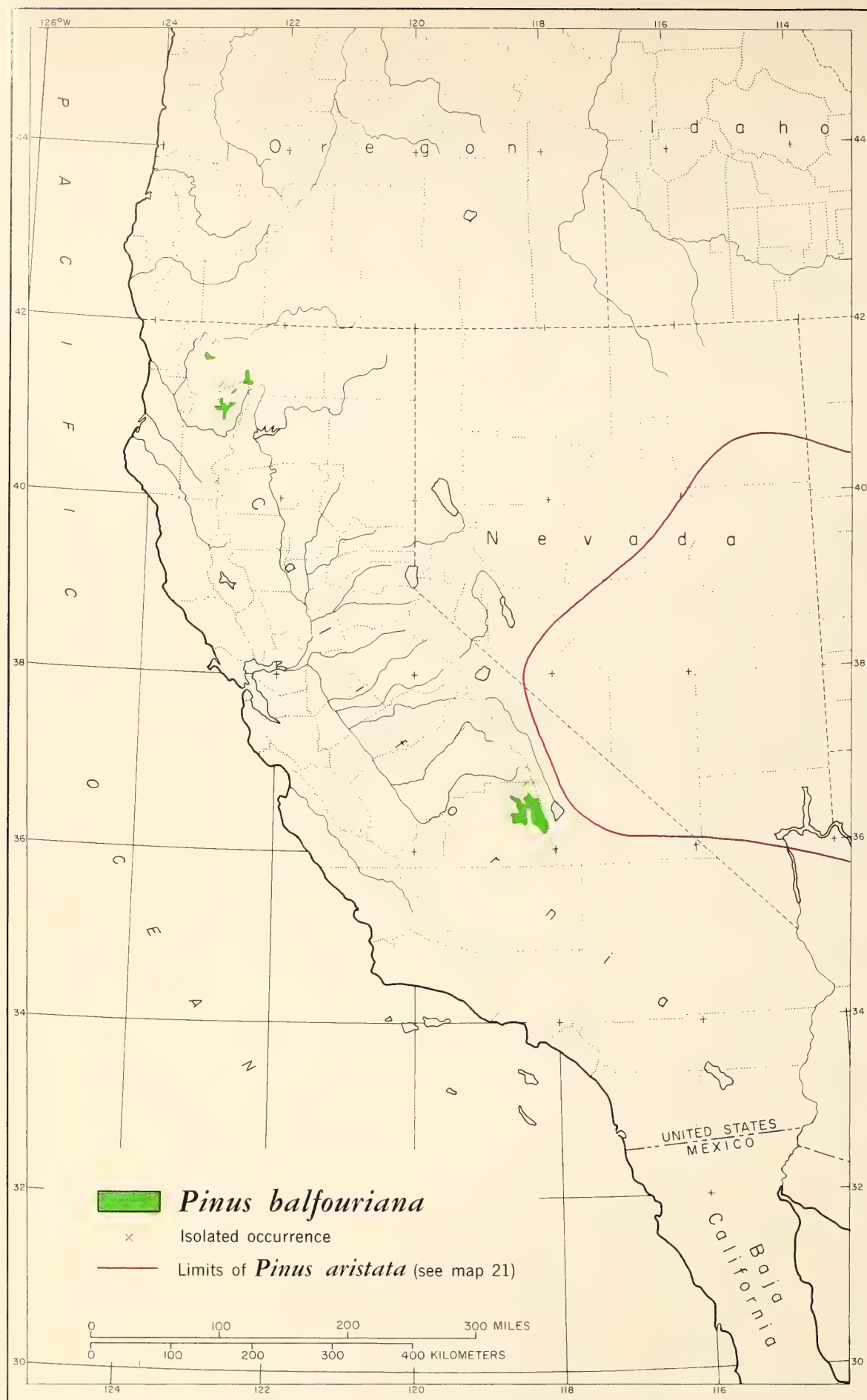
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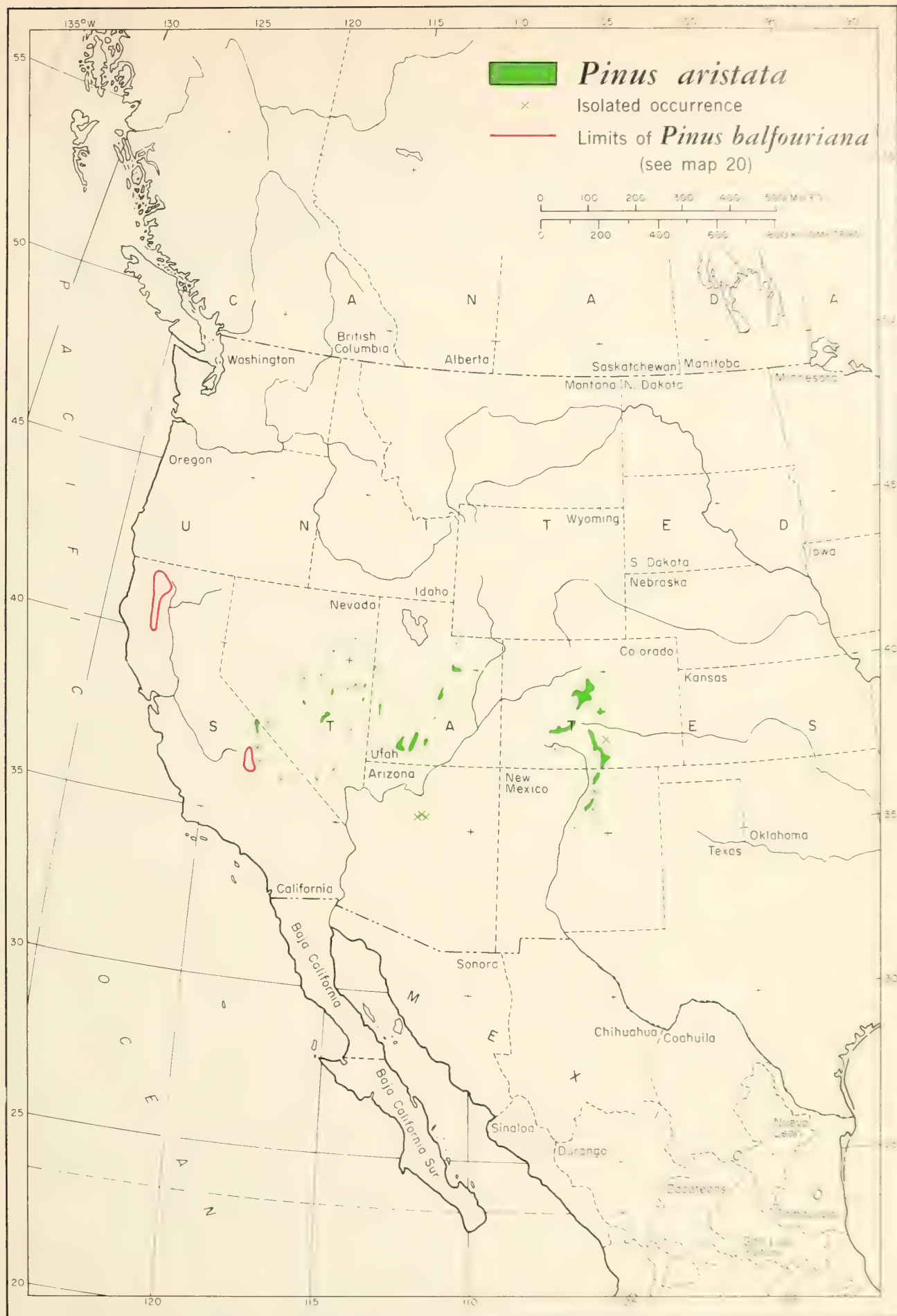
Map 19a



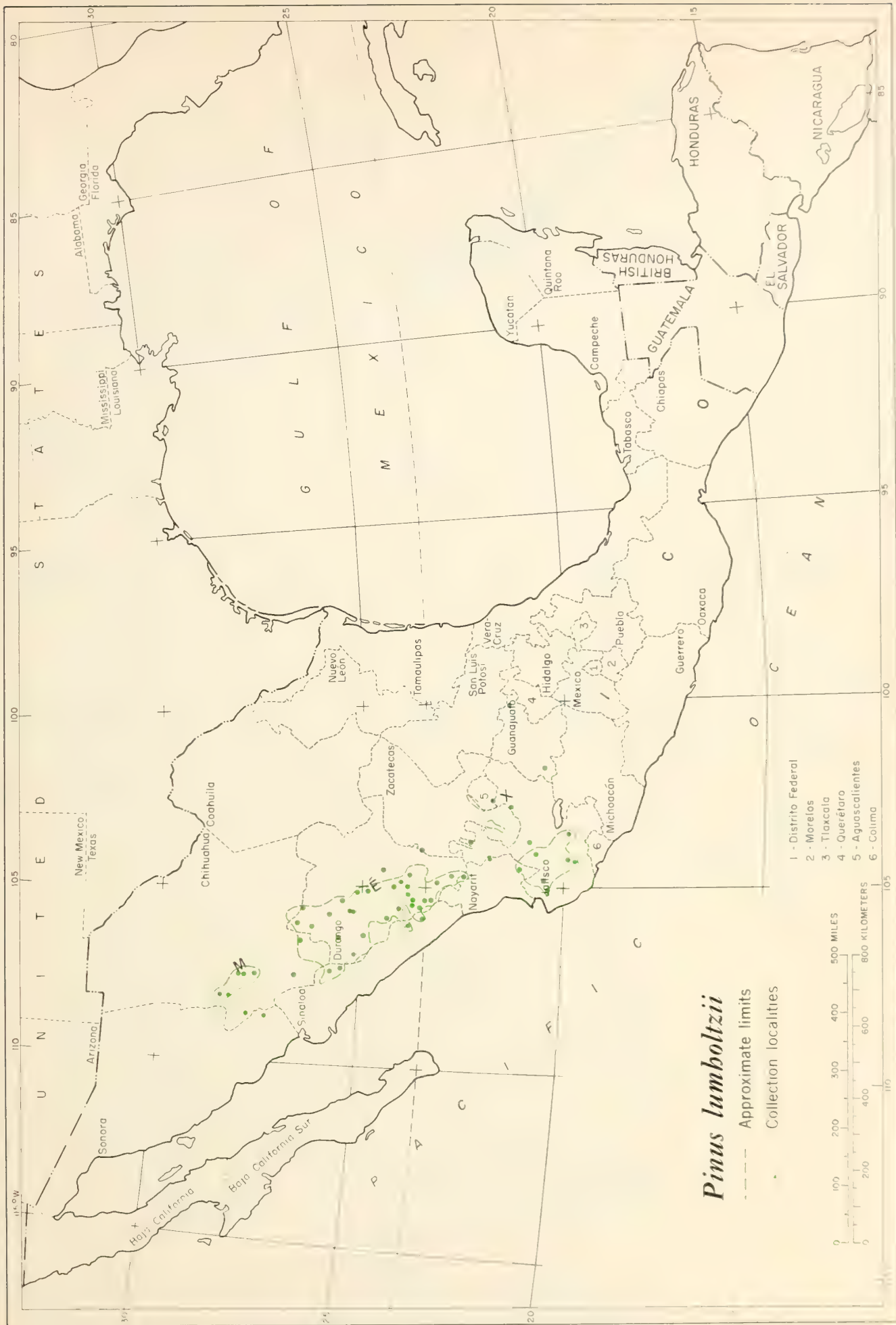
Map 19b



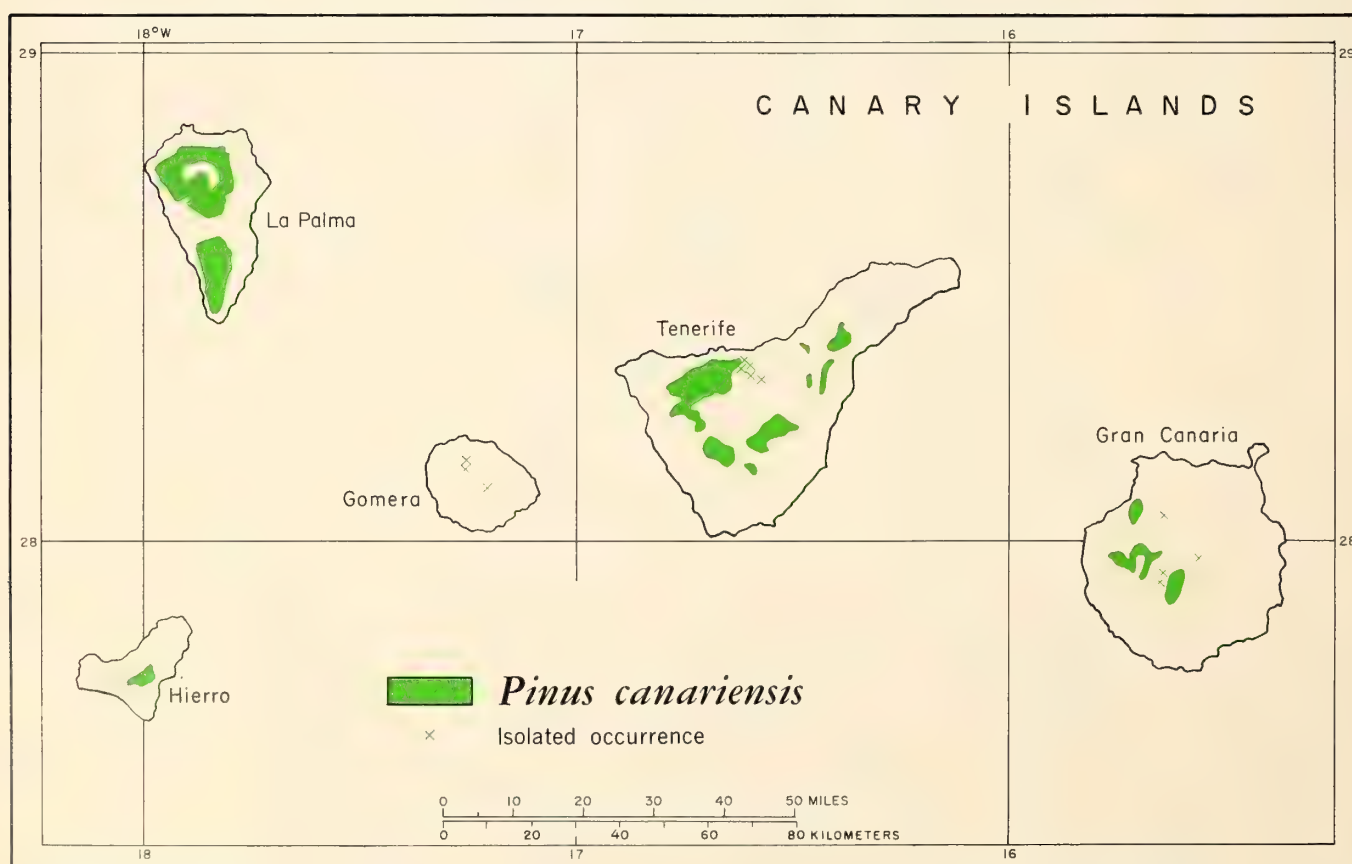
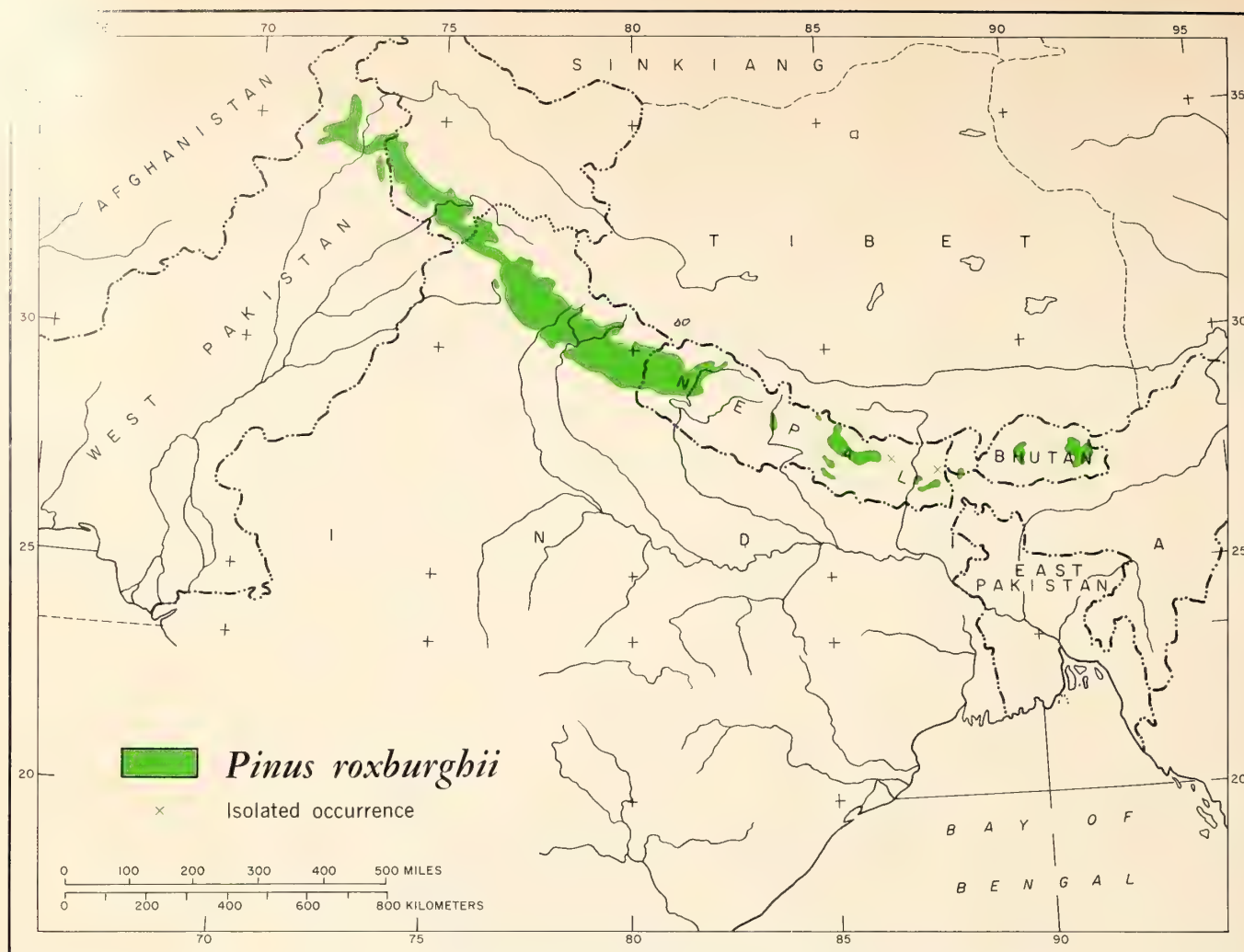
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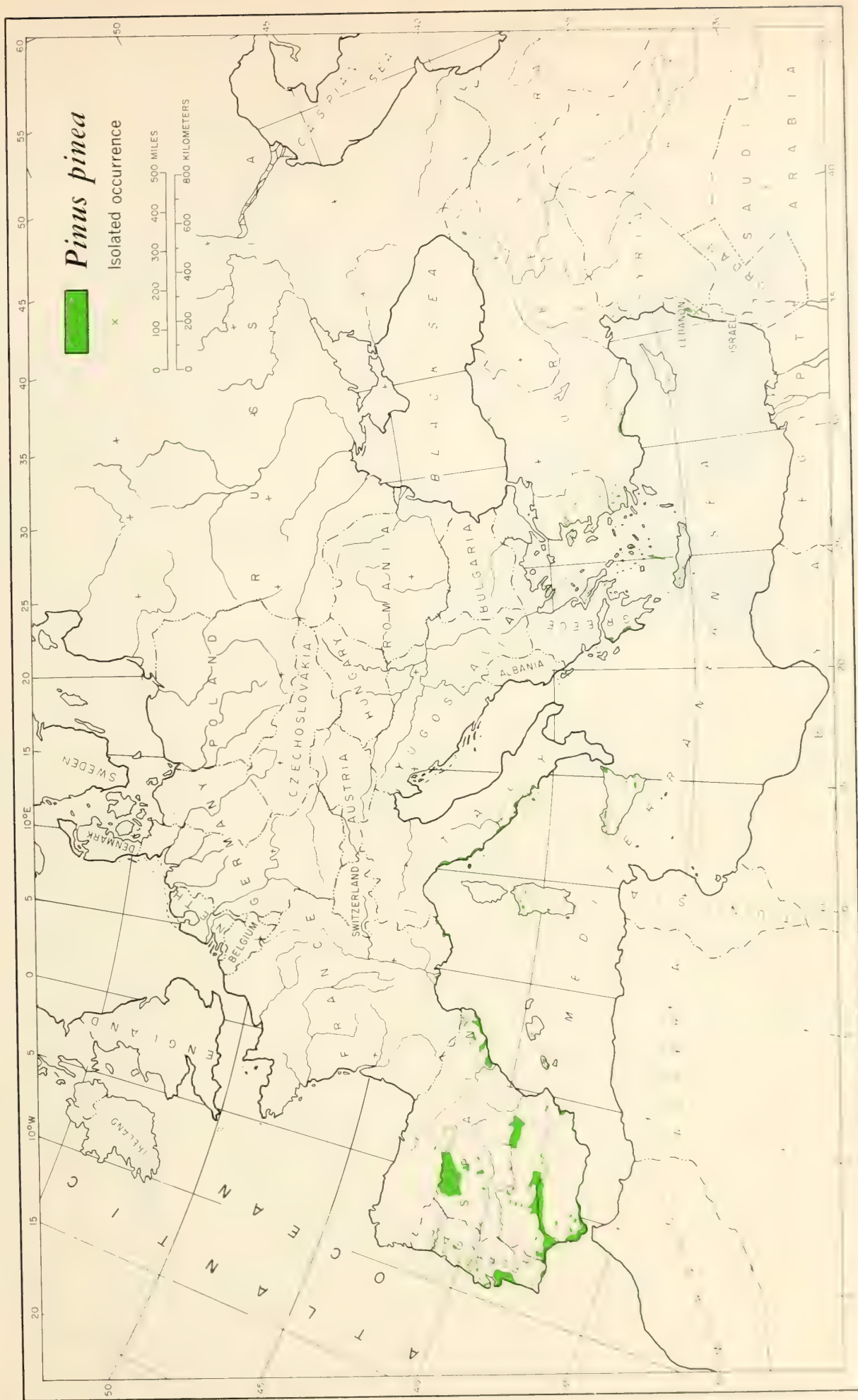
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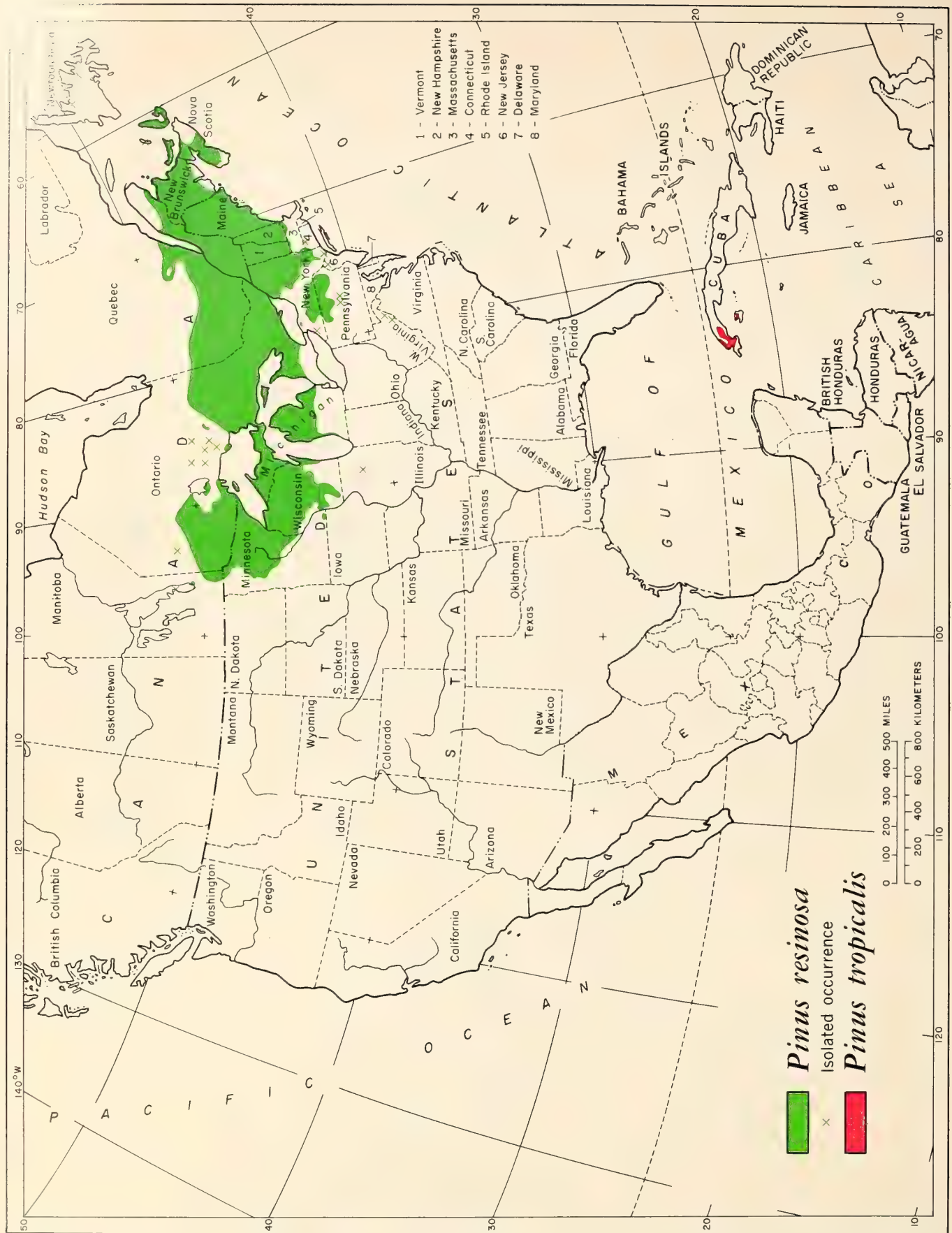
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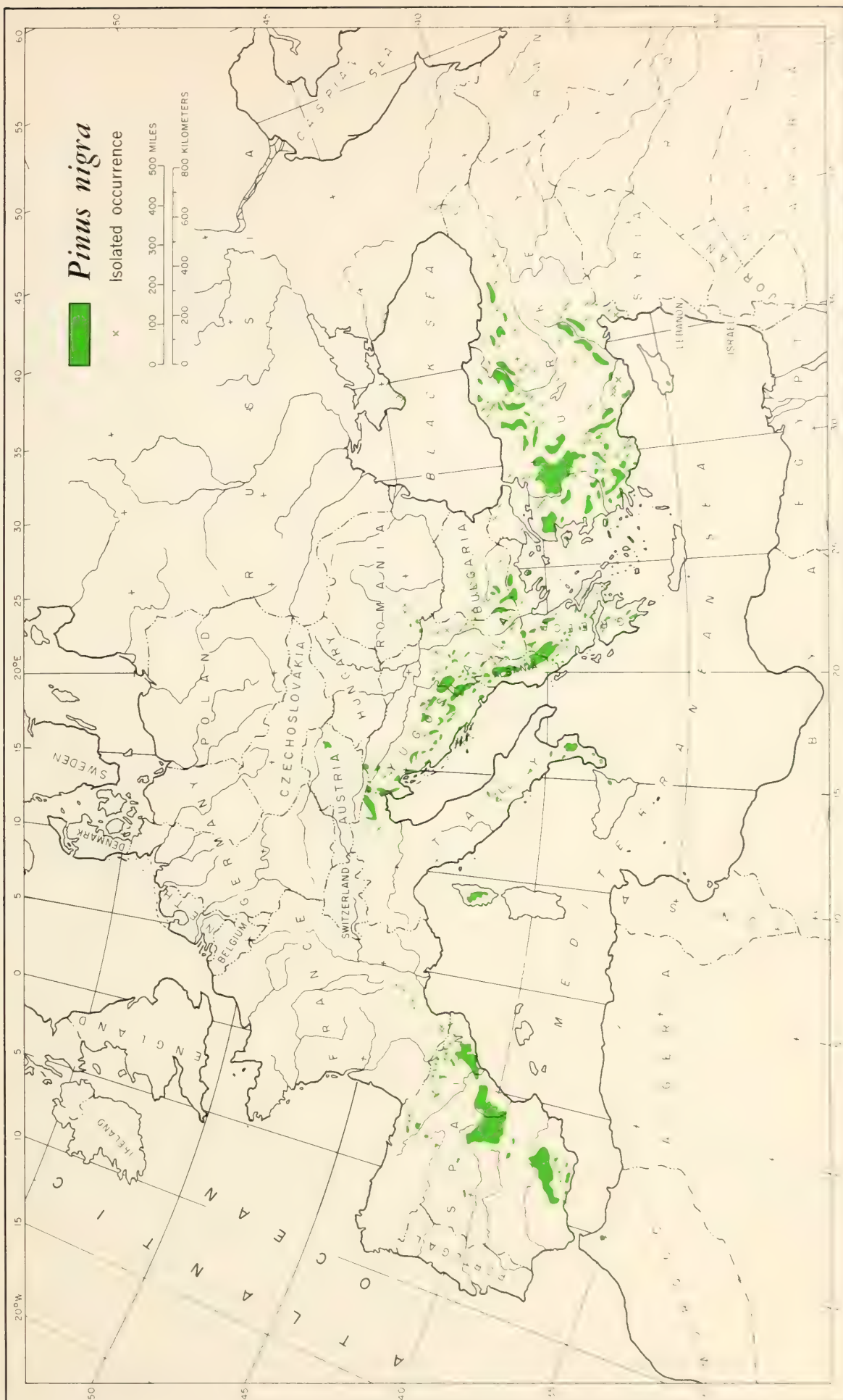


Map 24a (above). Map 24b (below).

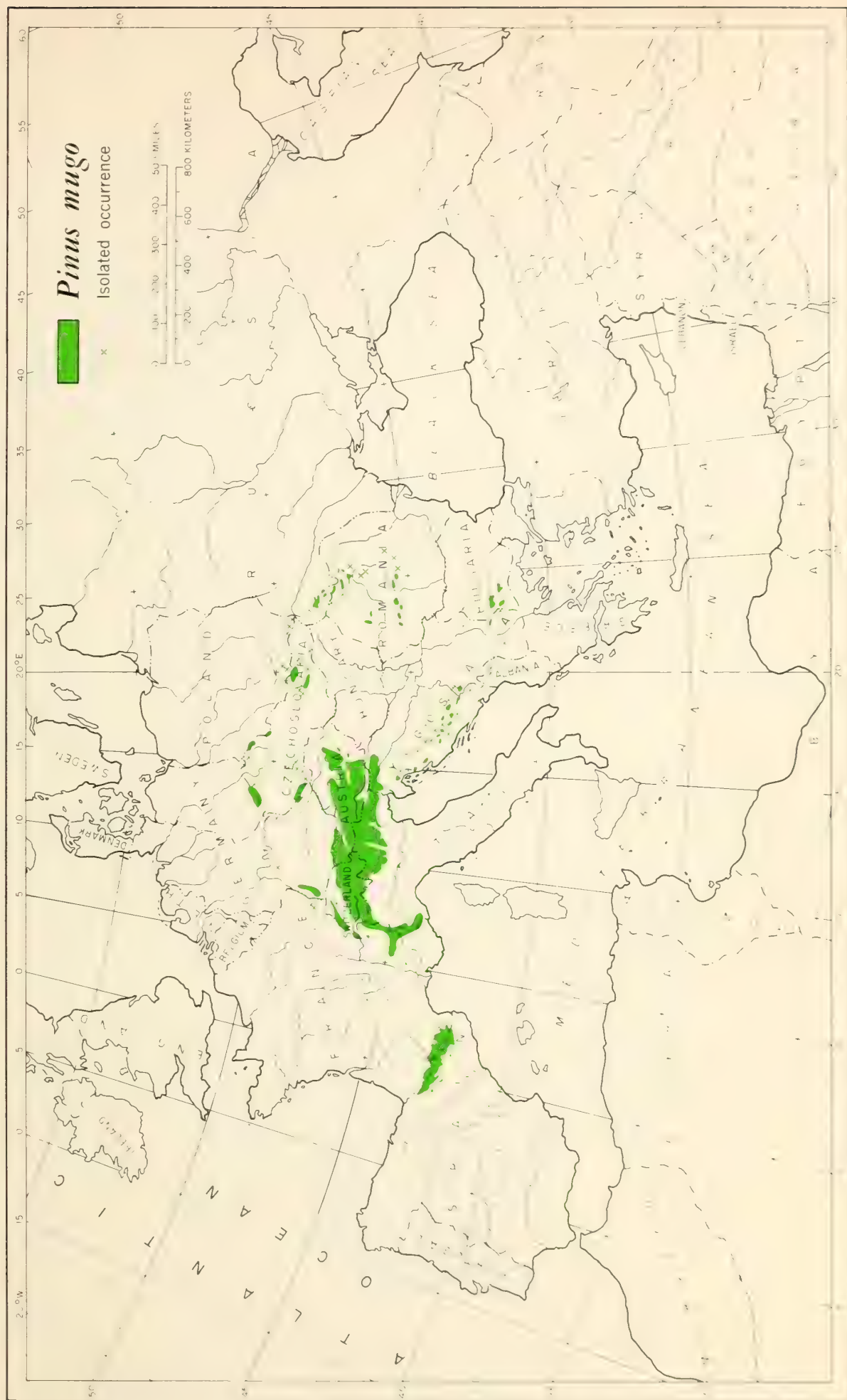


Map 25

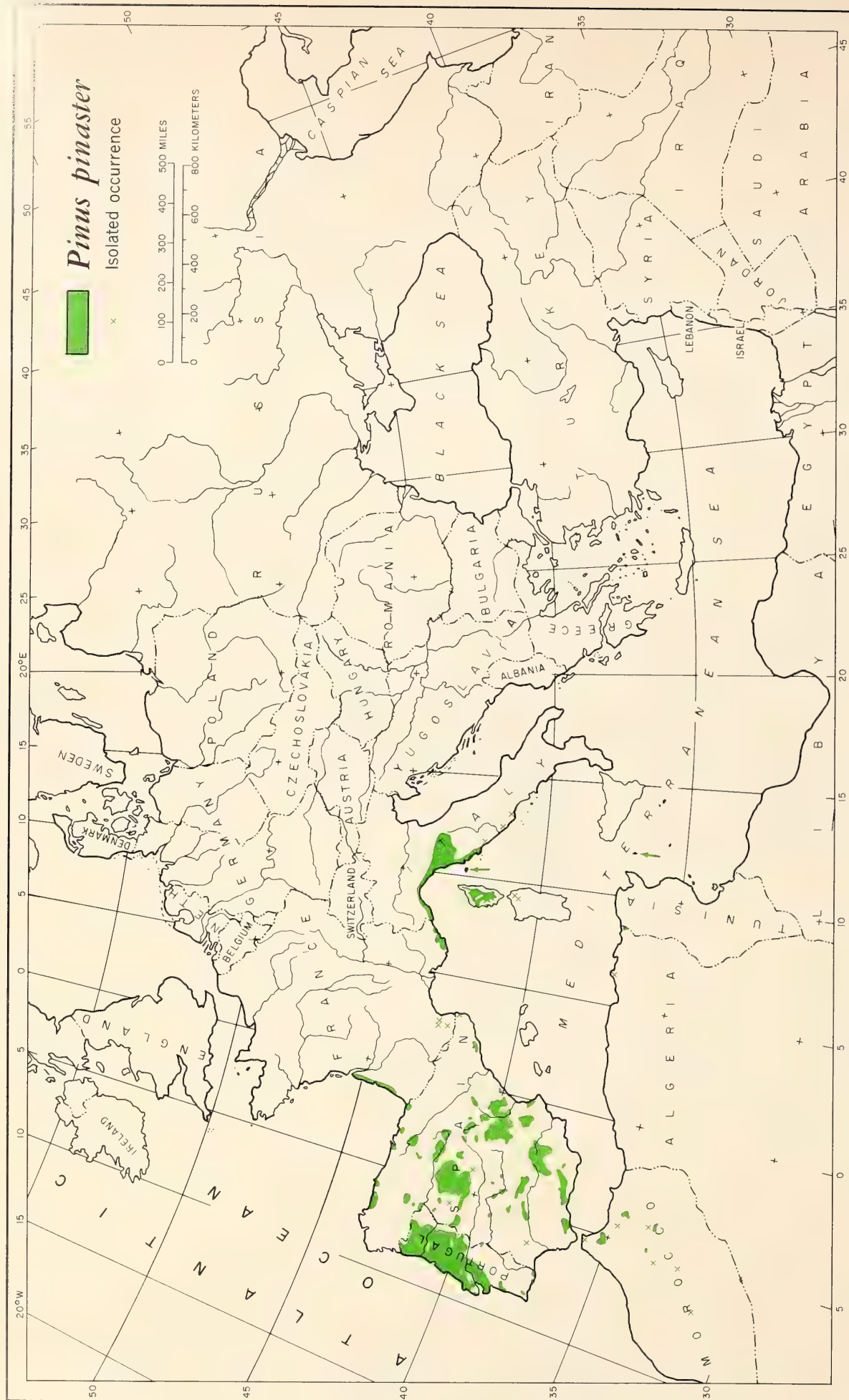


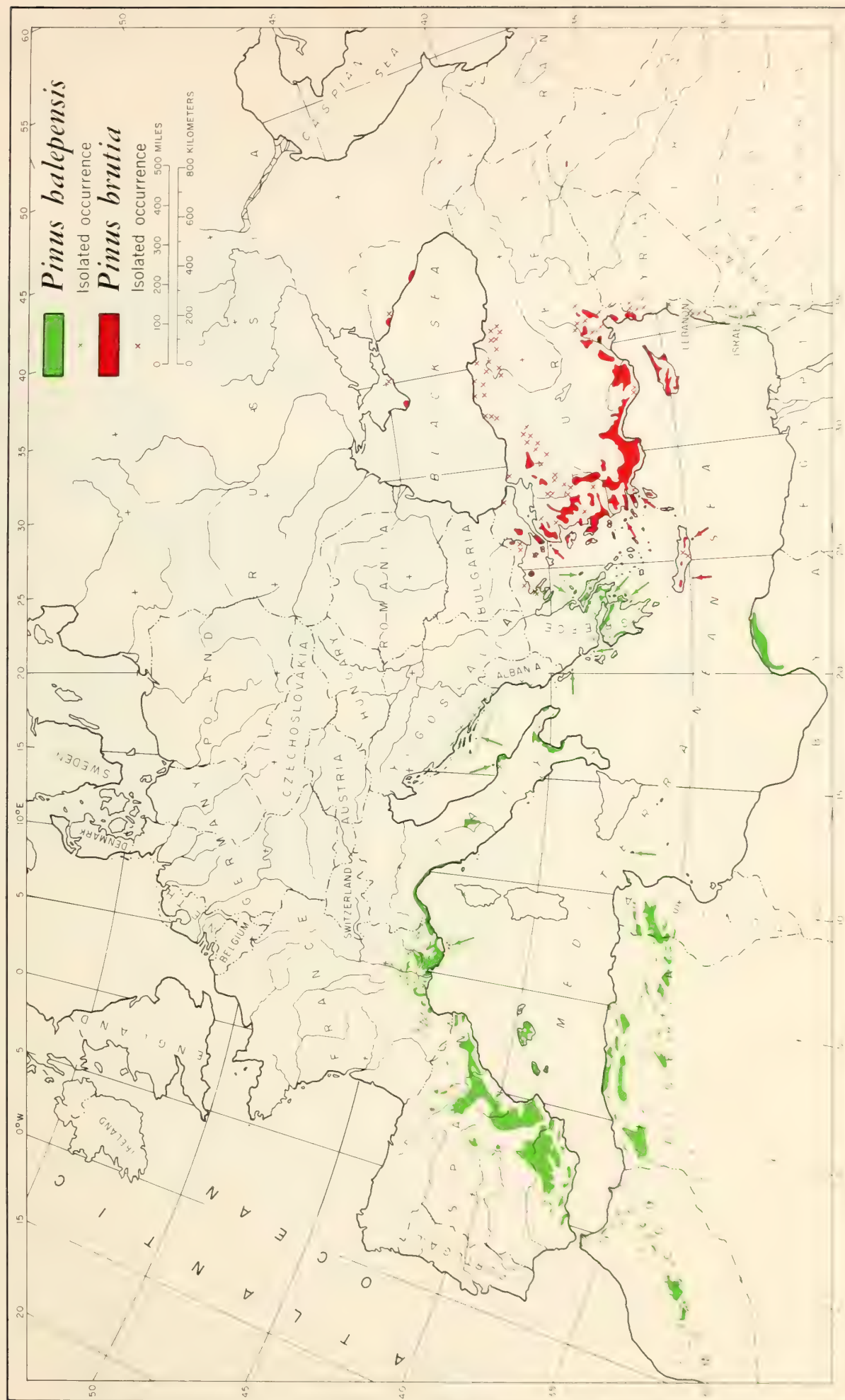


Map 27



Map 29

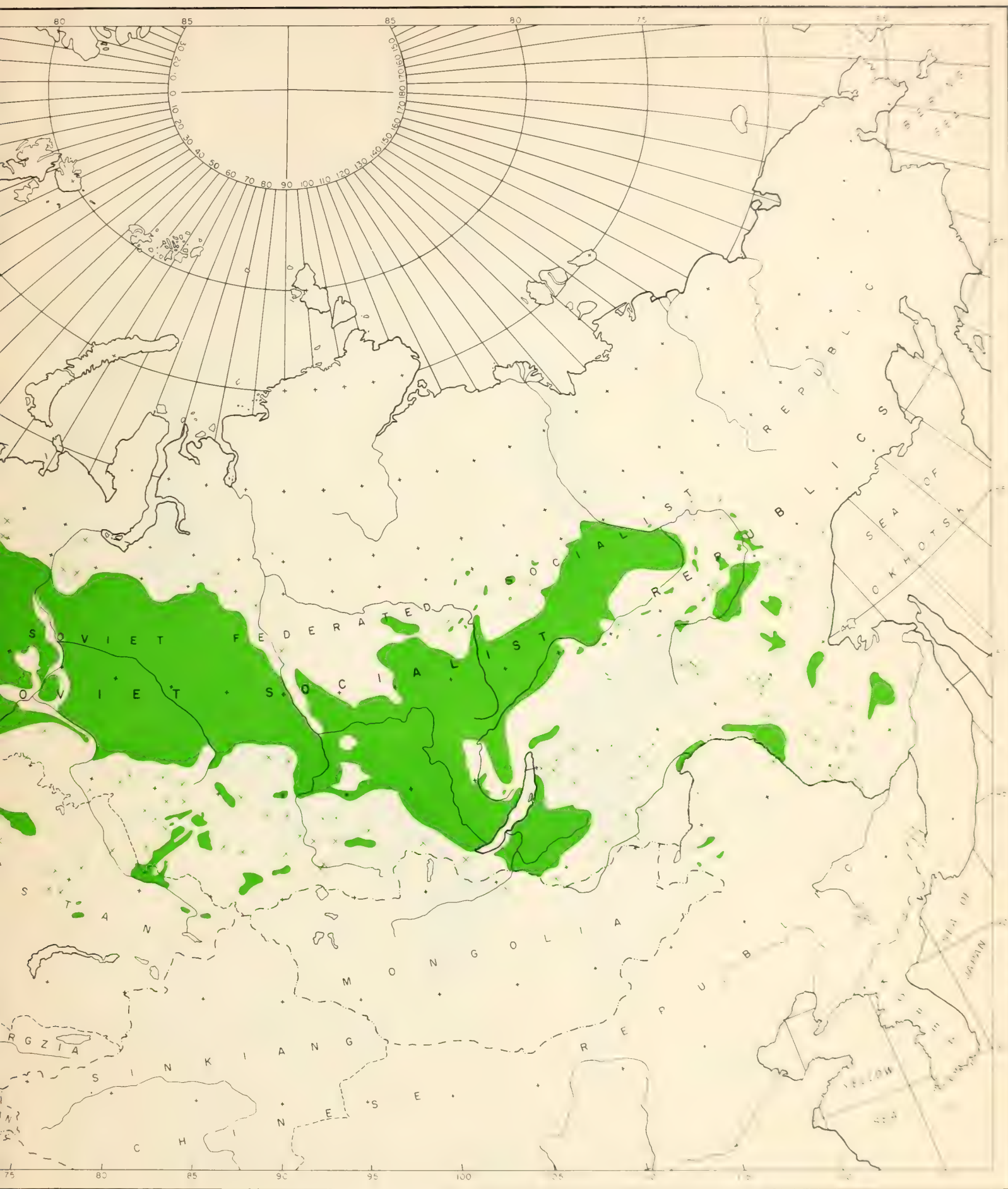




Map 31



Map 32

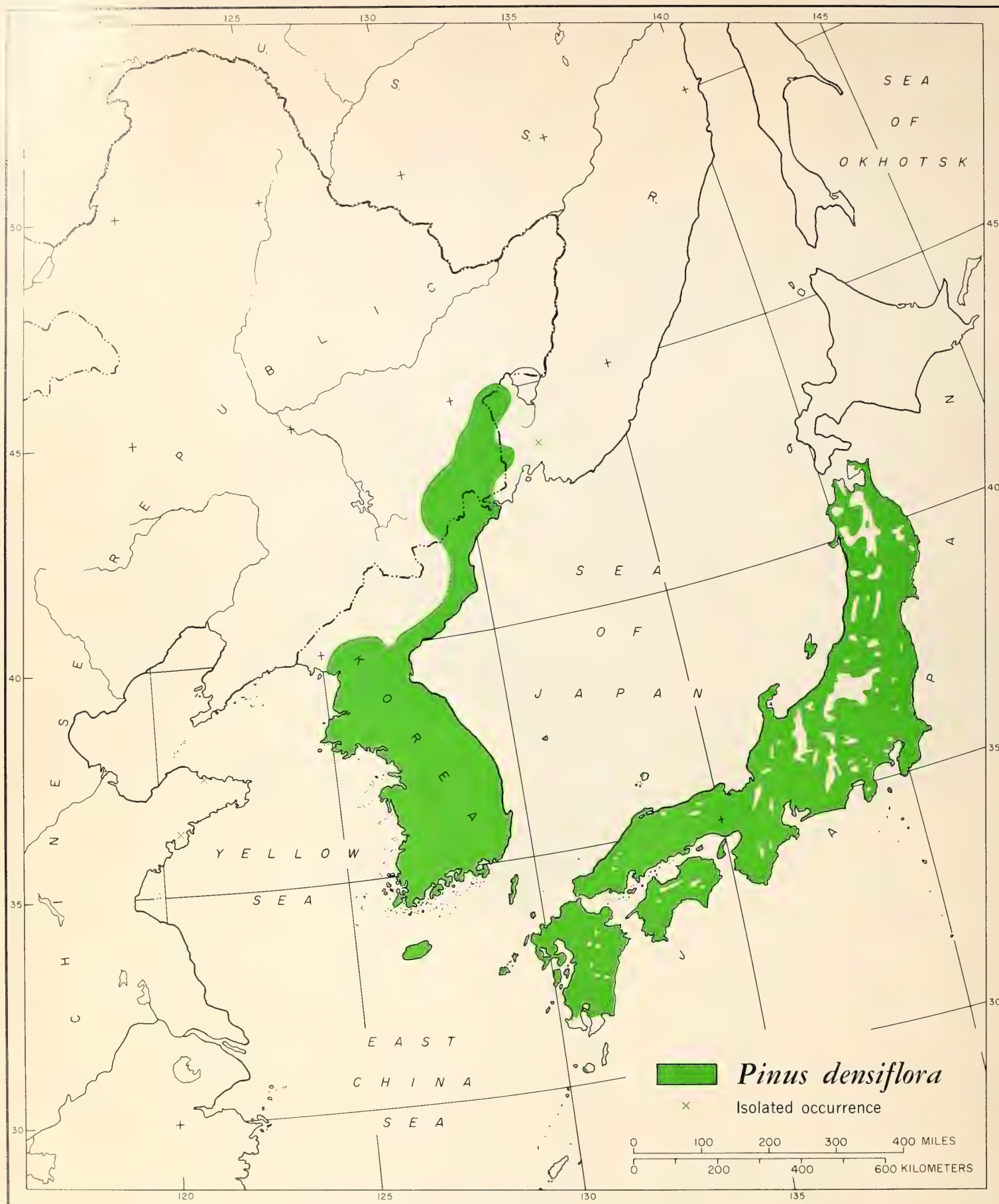


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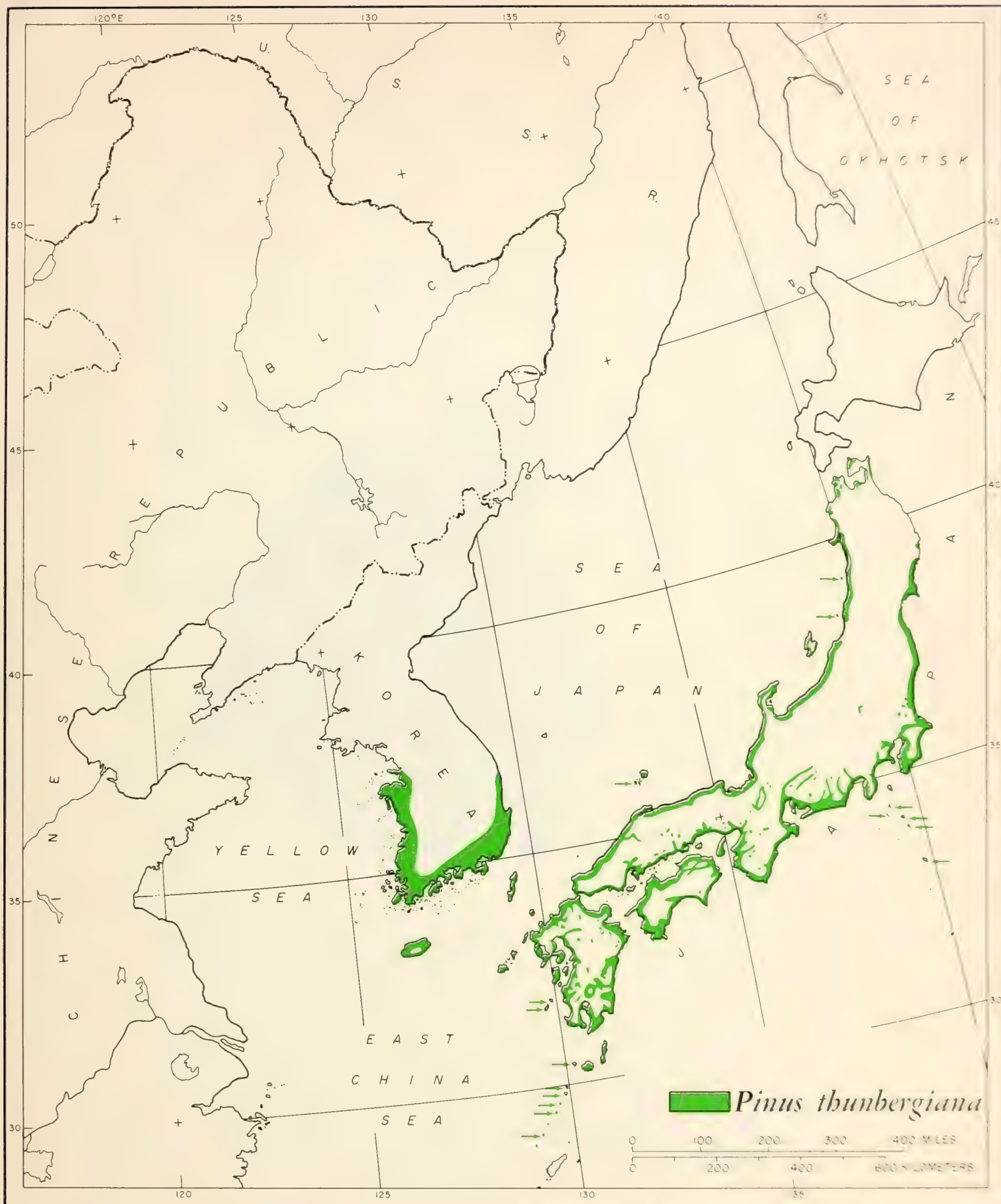


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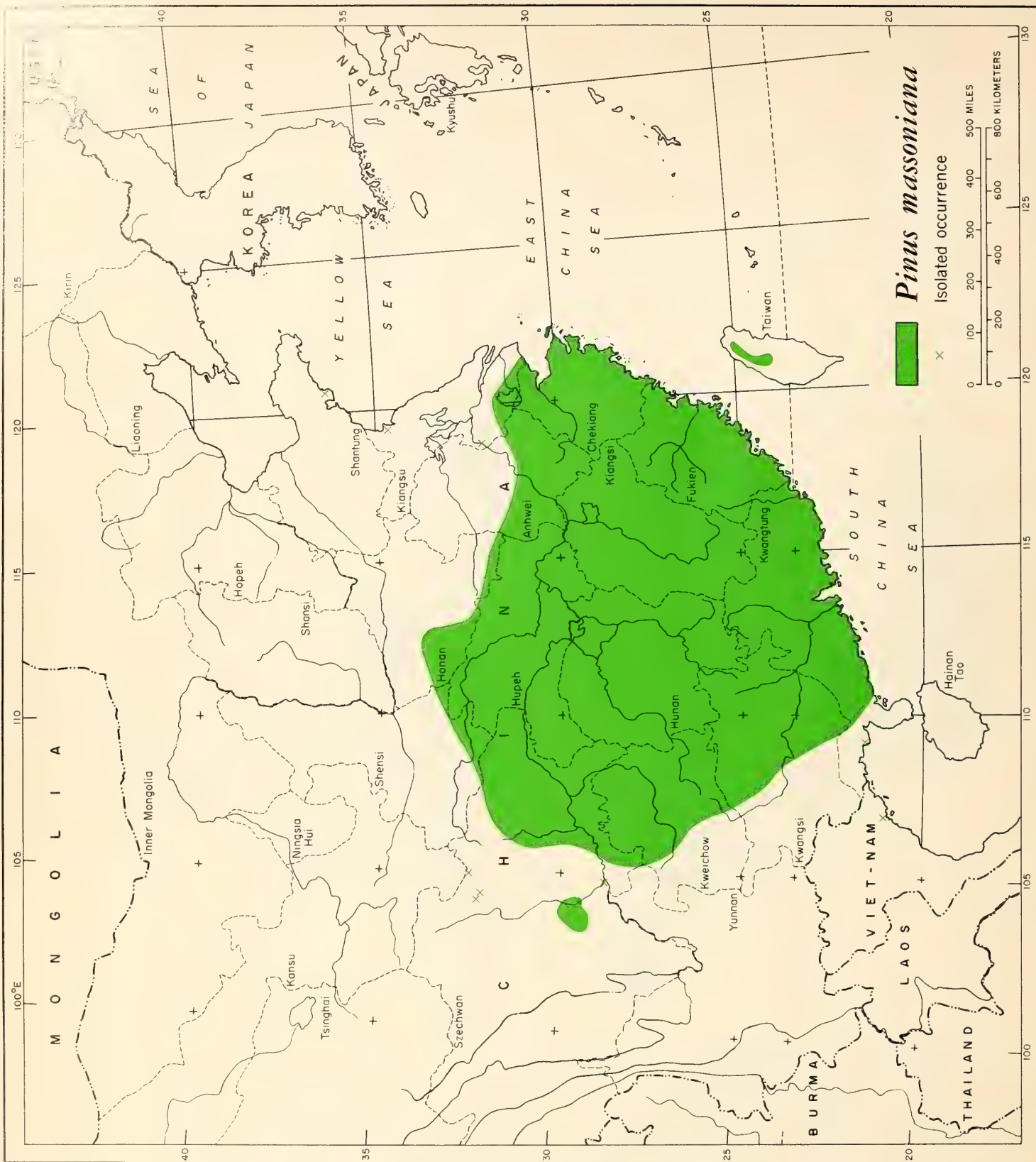
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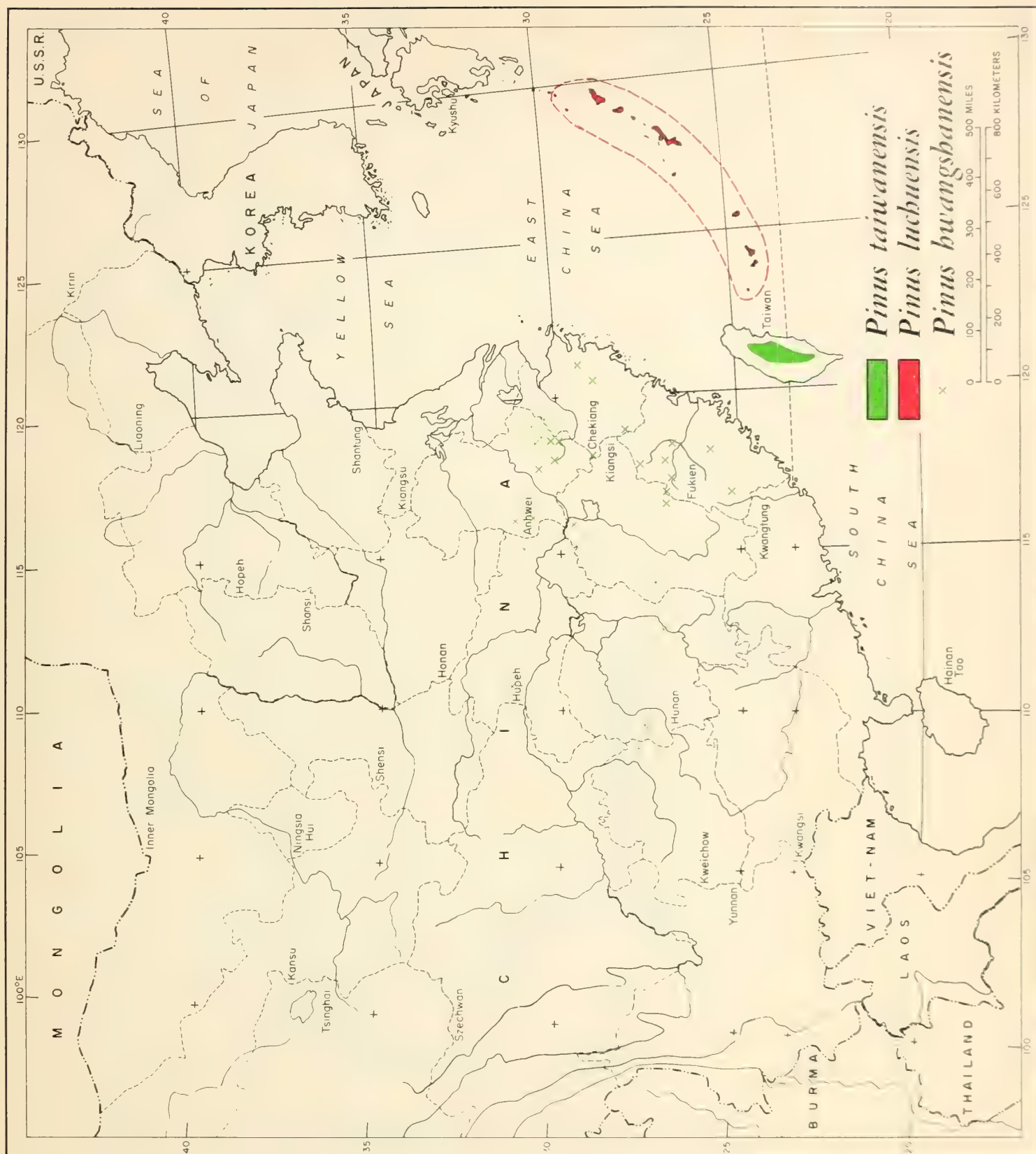
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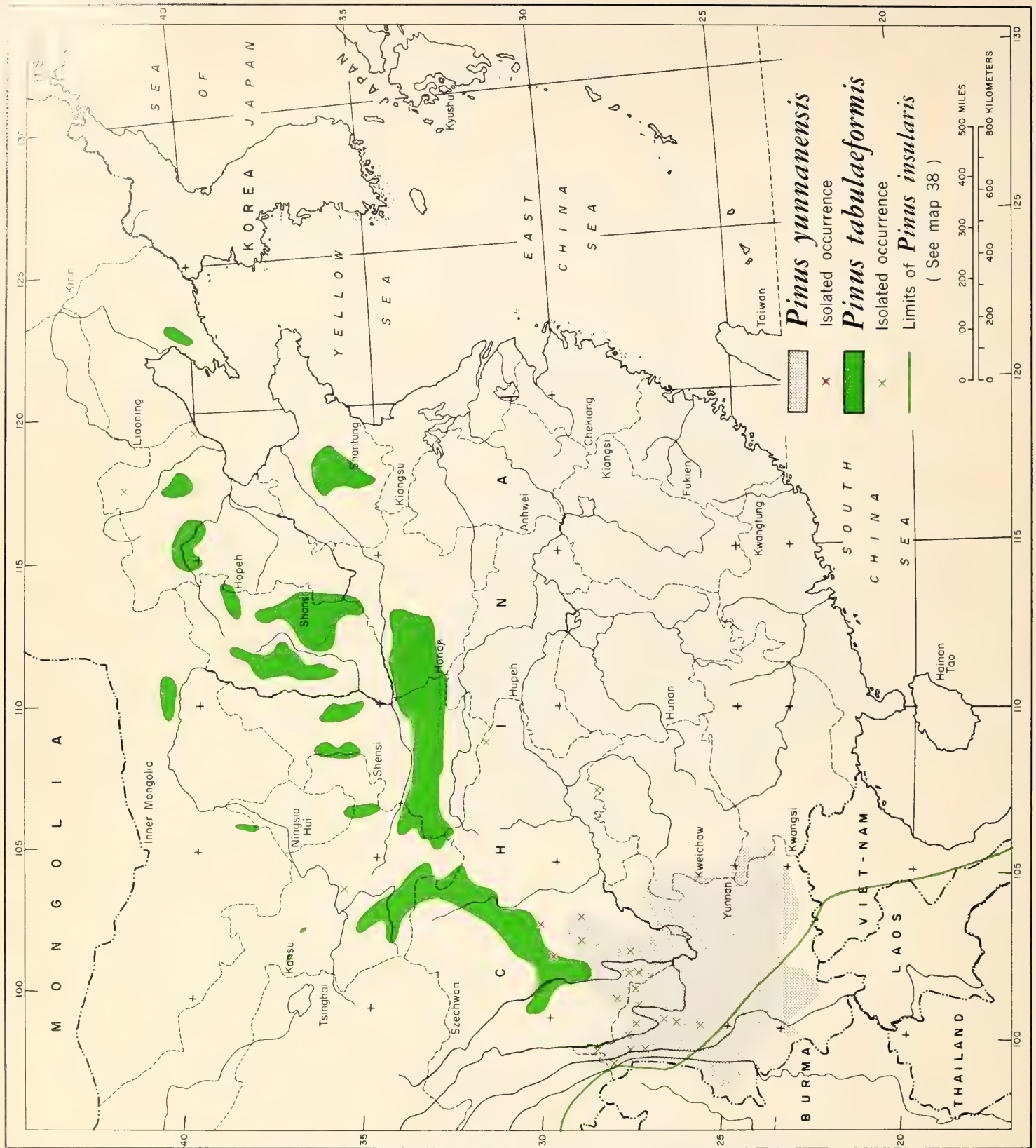
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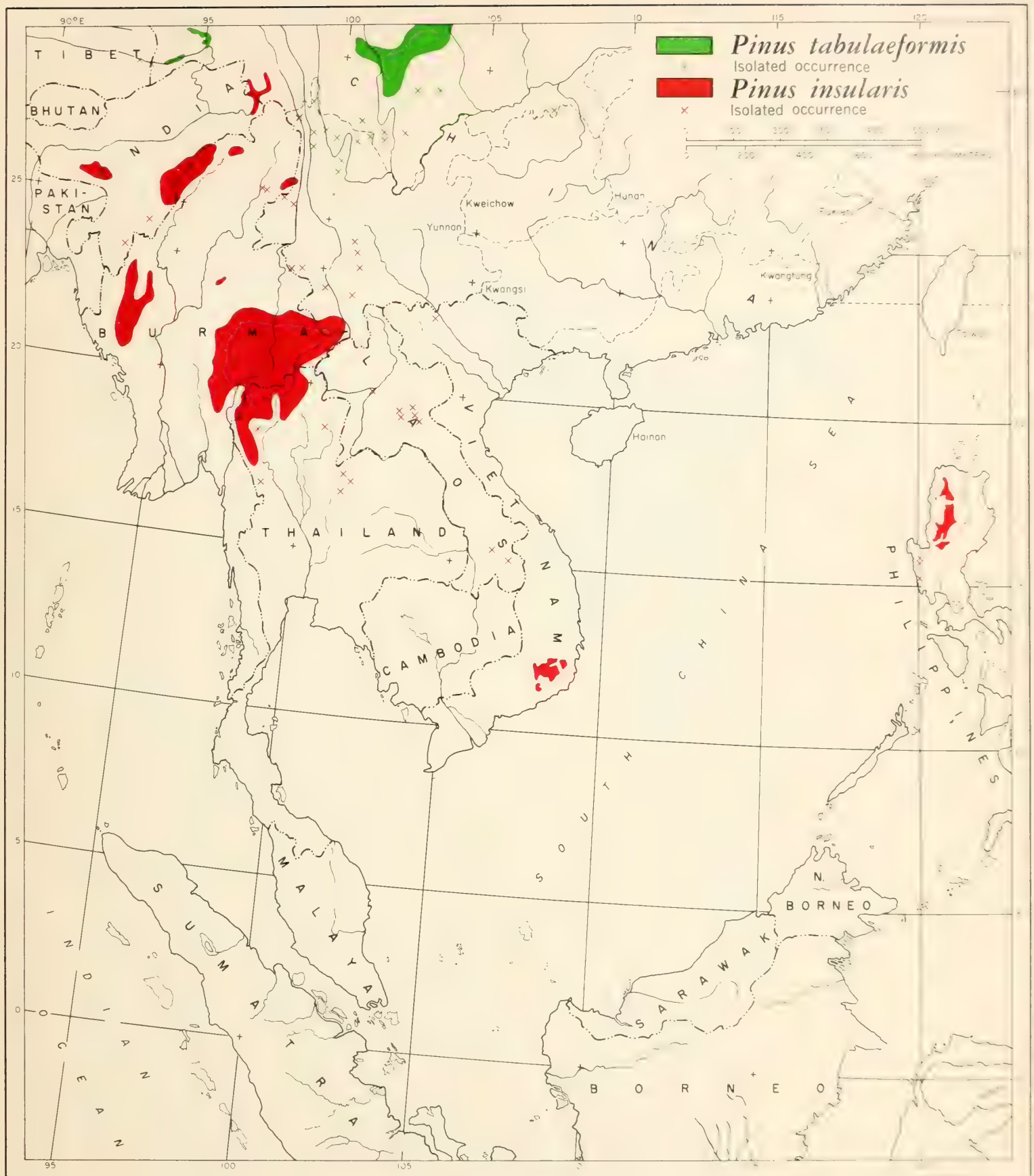
Map 35



Map 36



Map 37



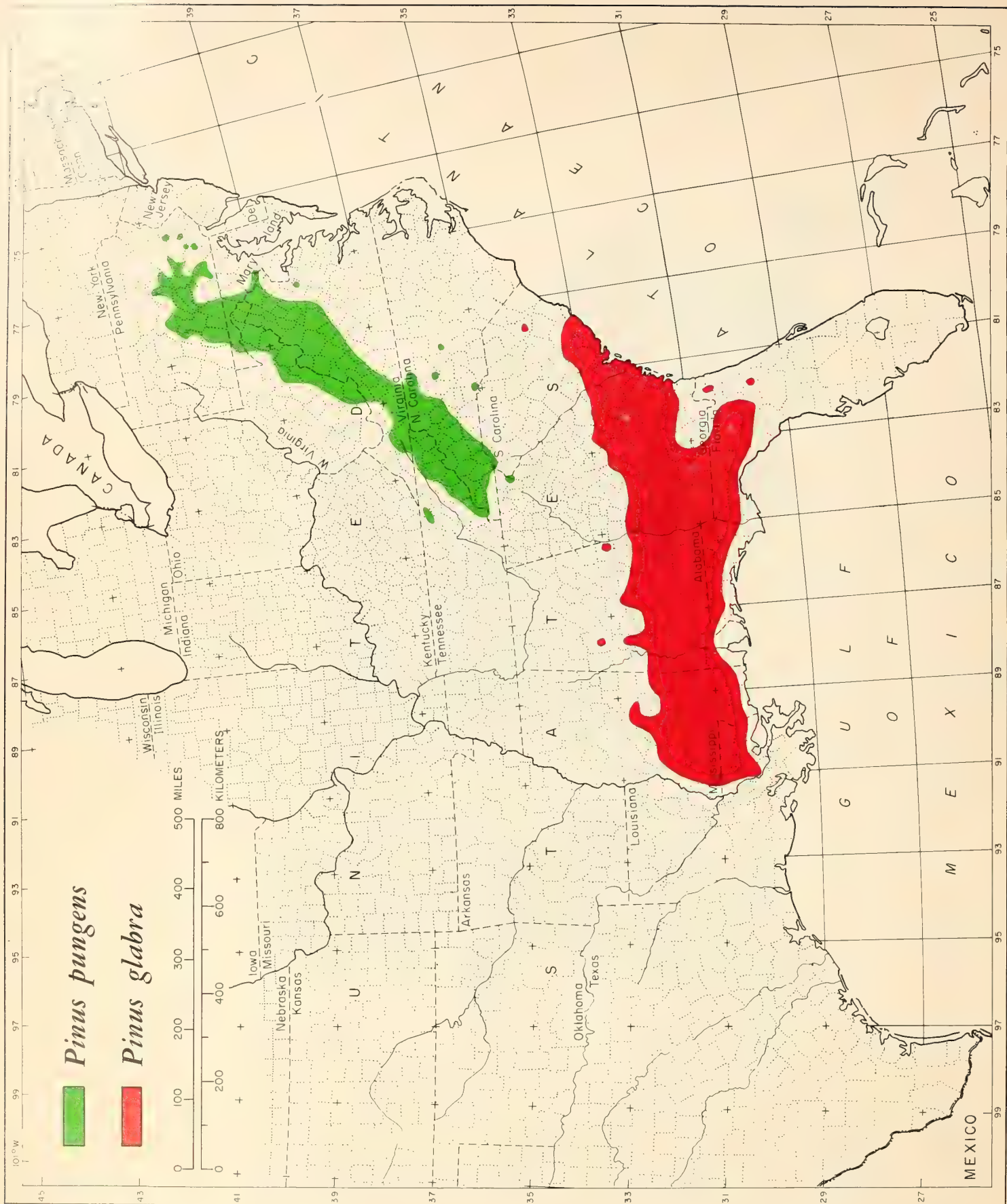
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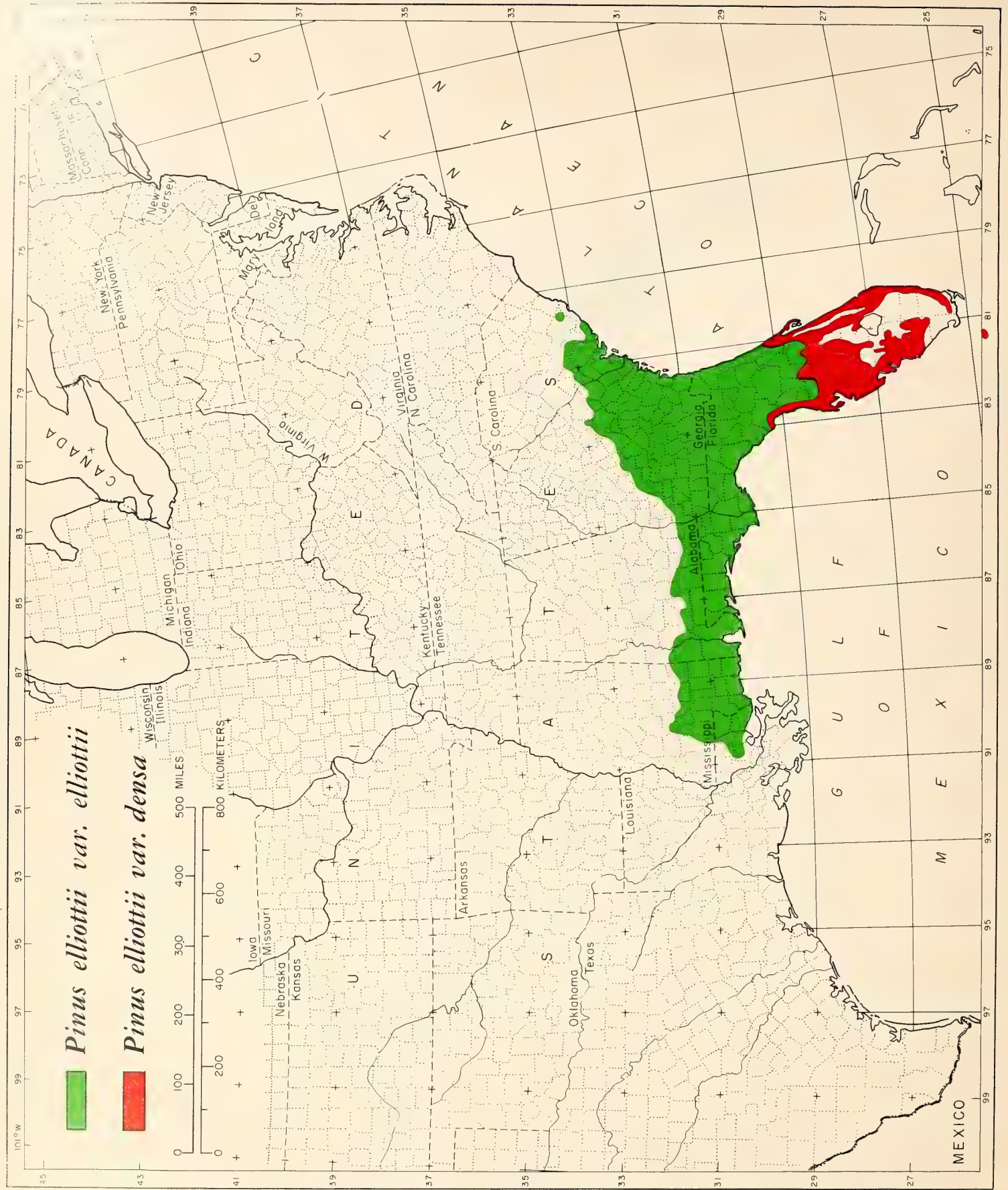
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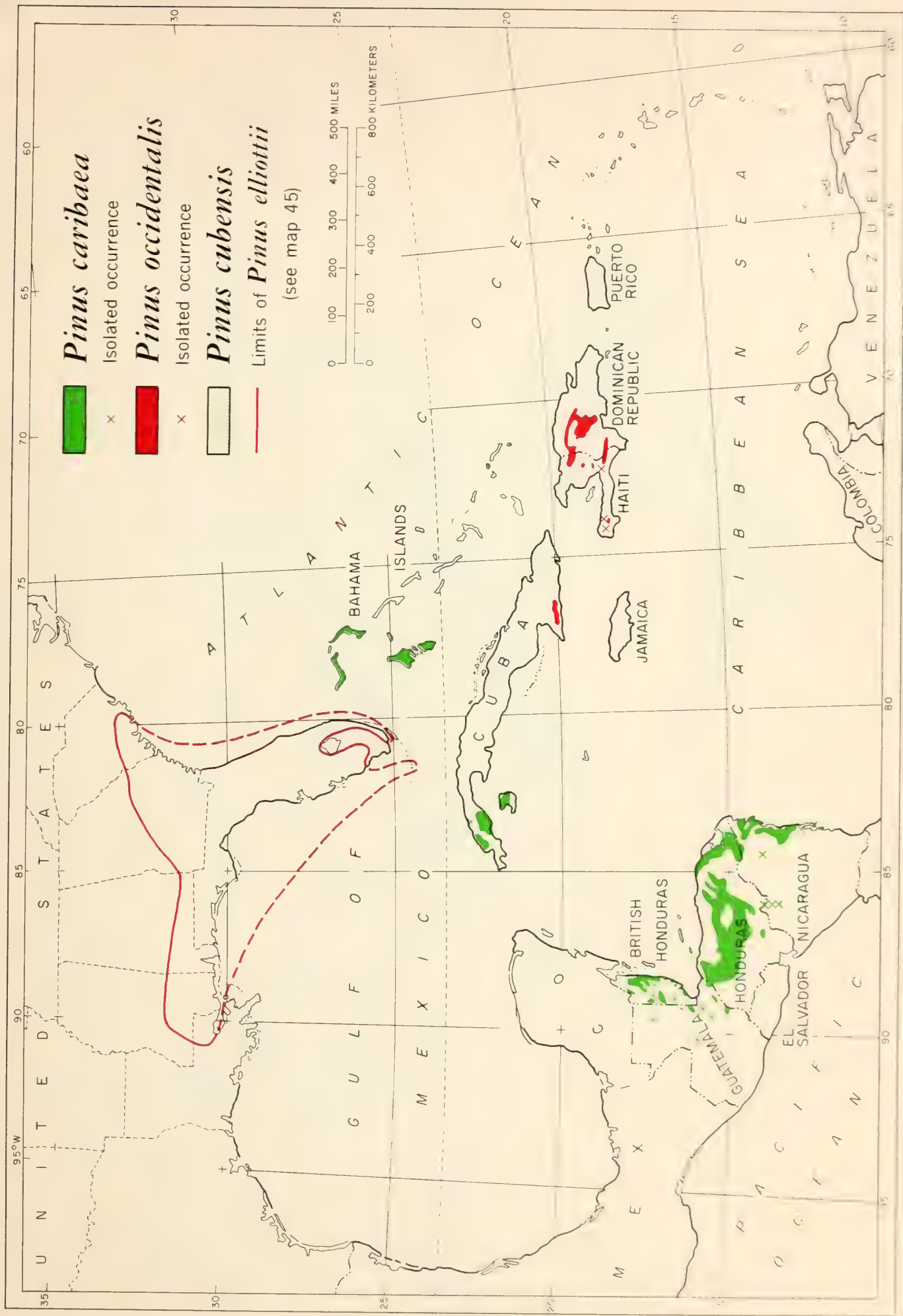
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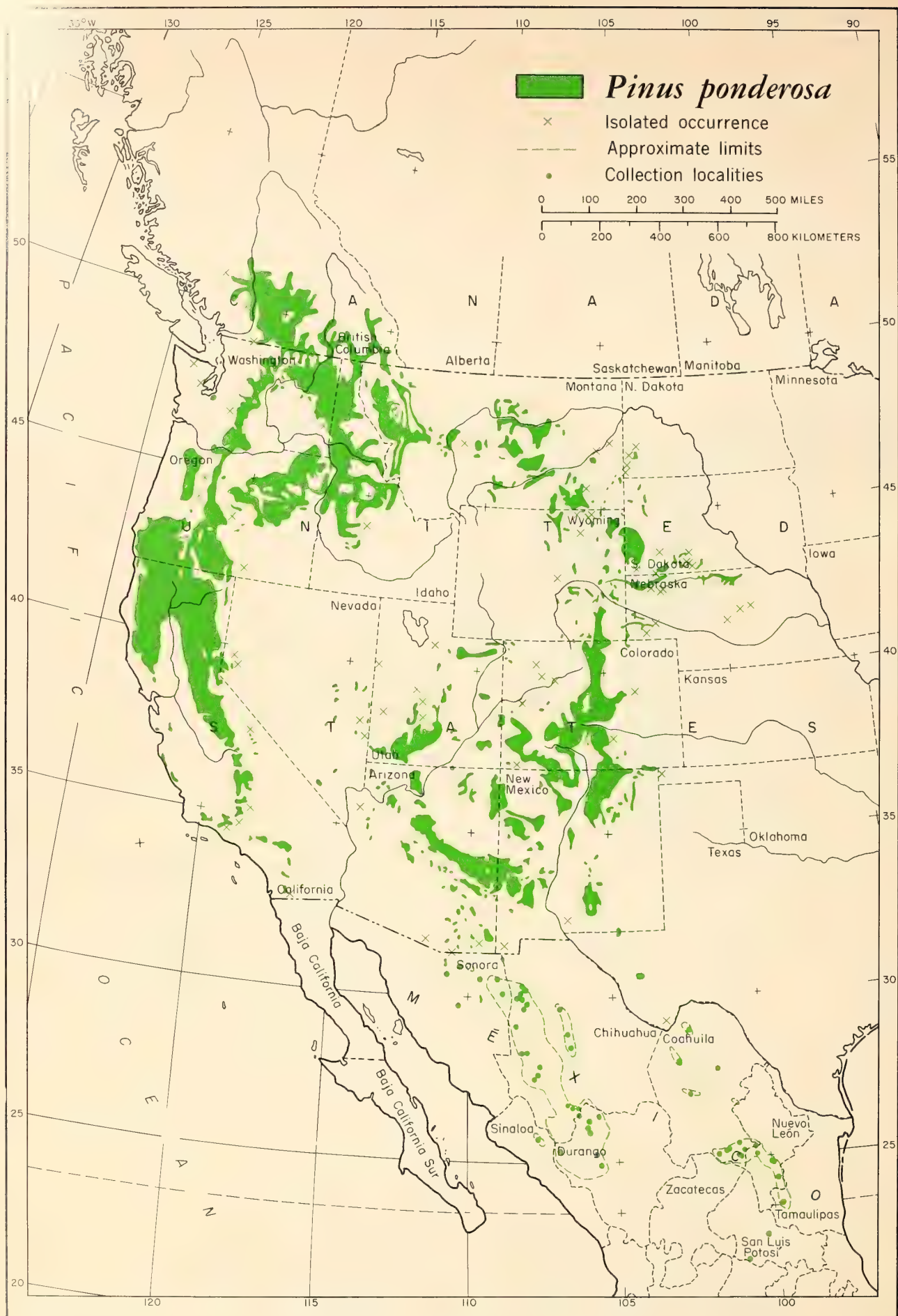
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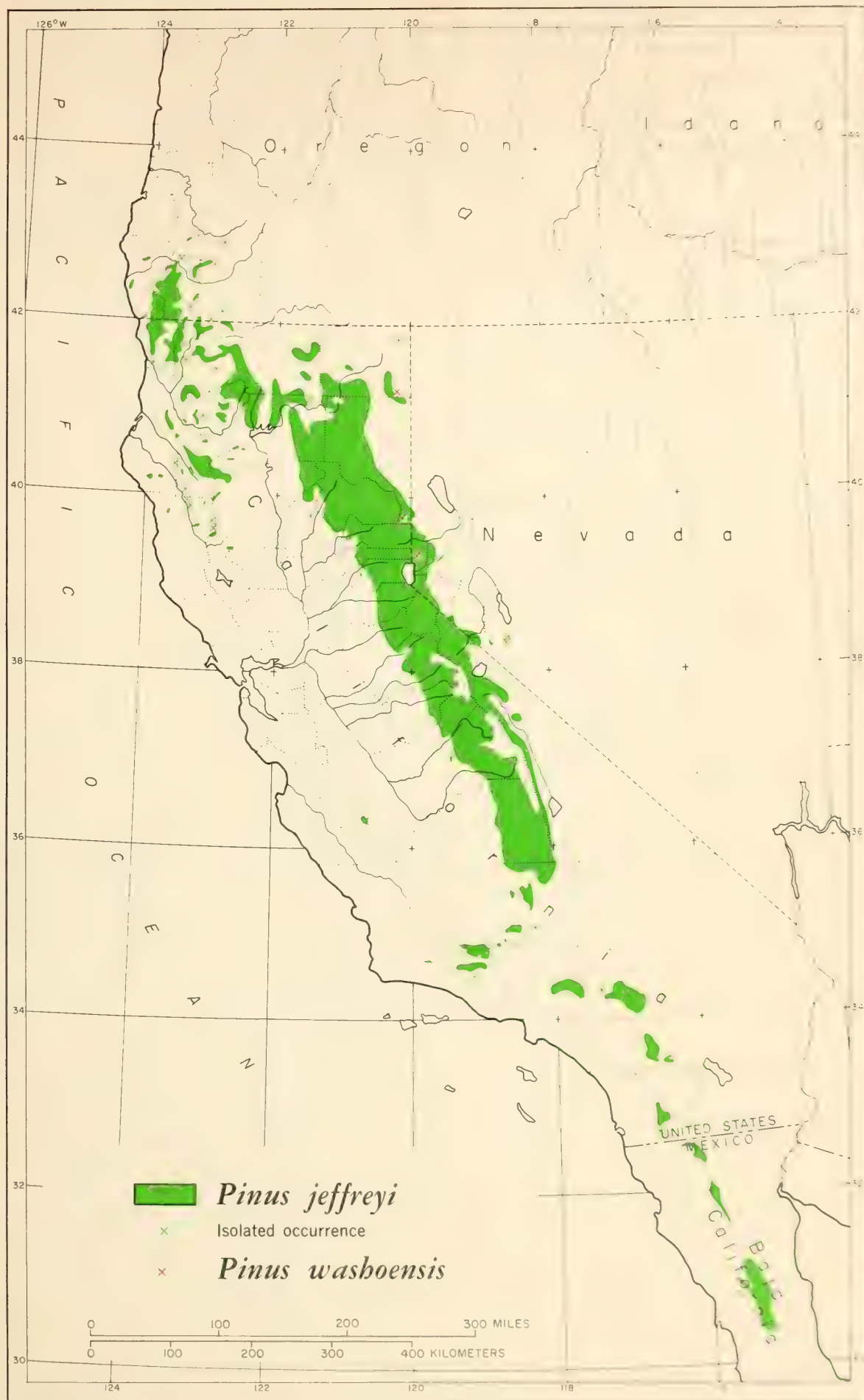
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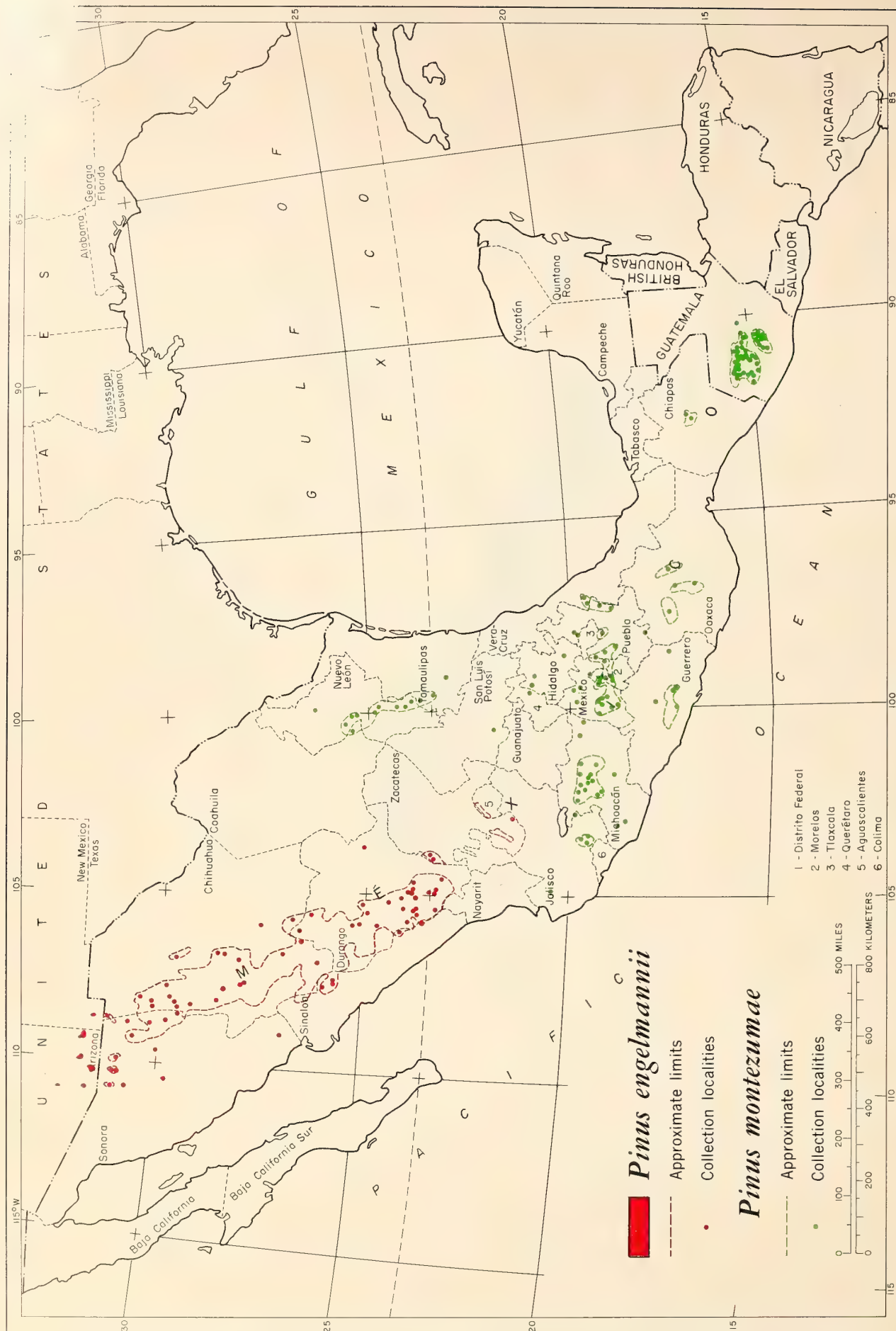
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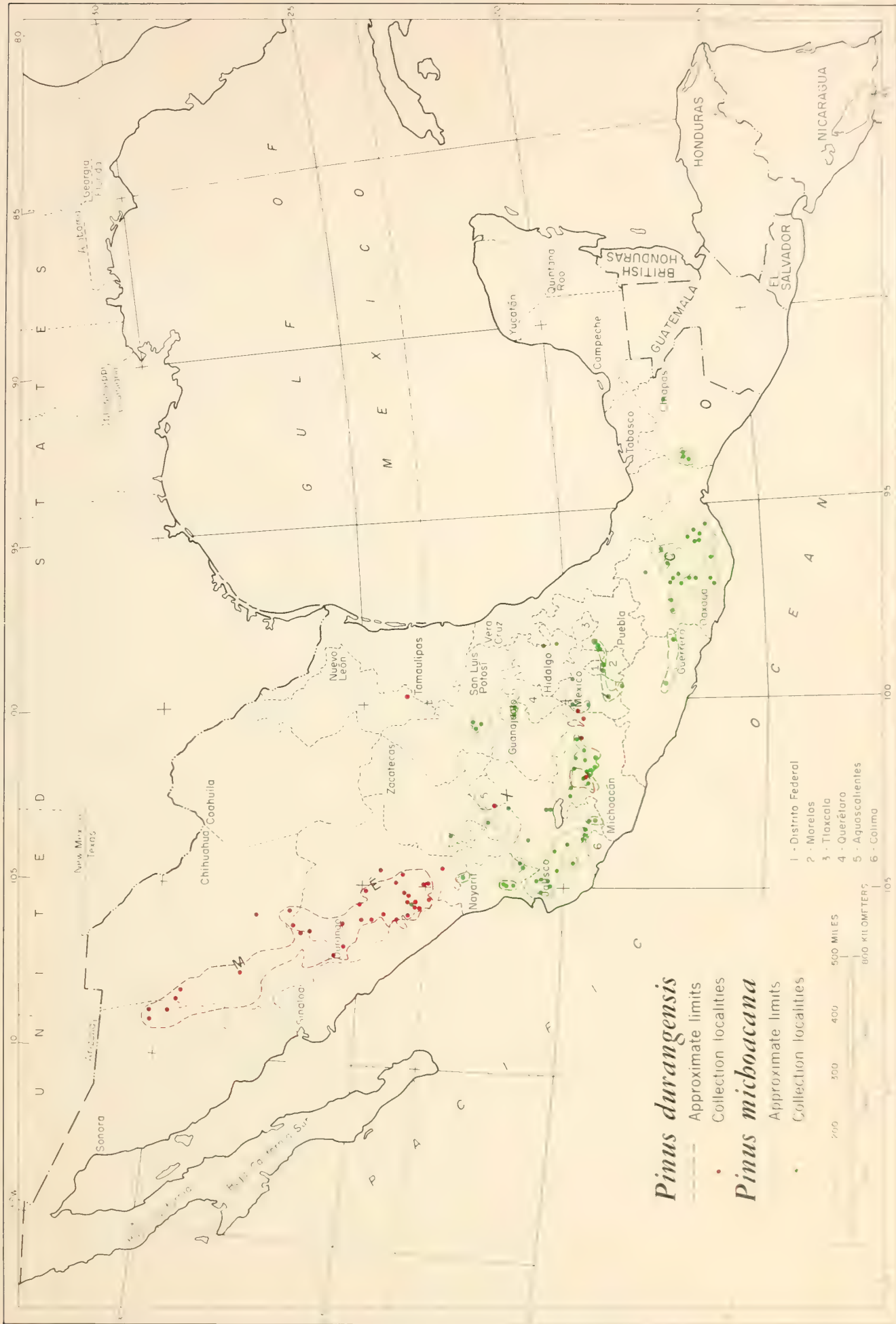
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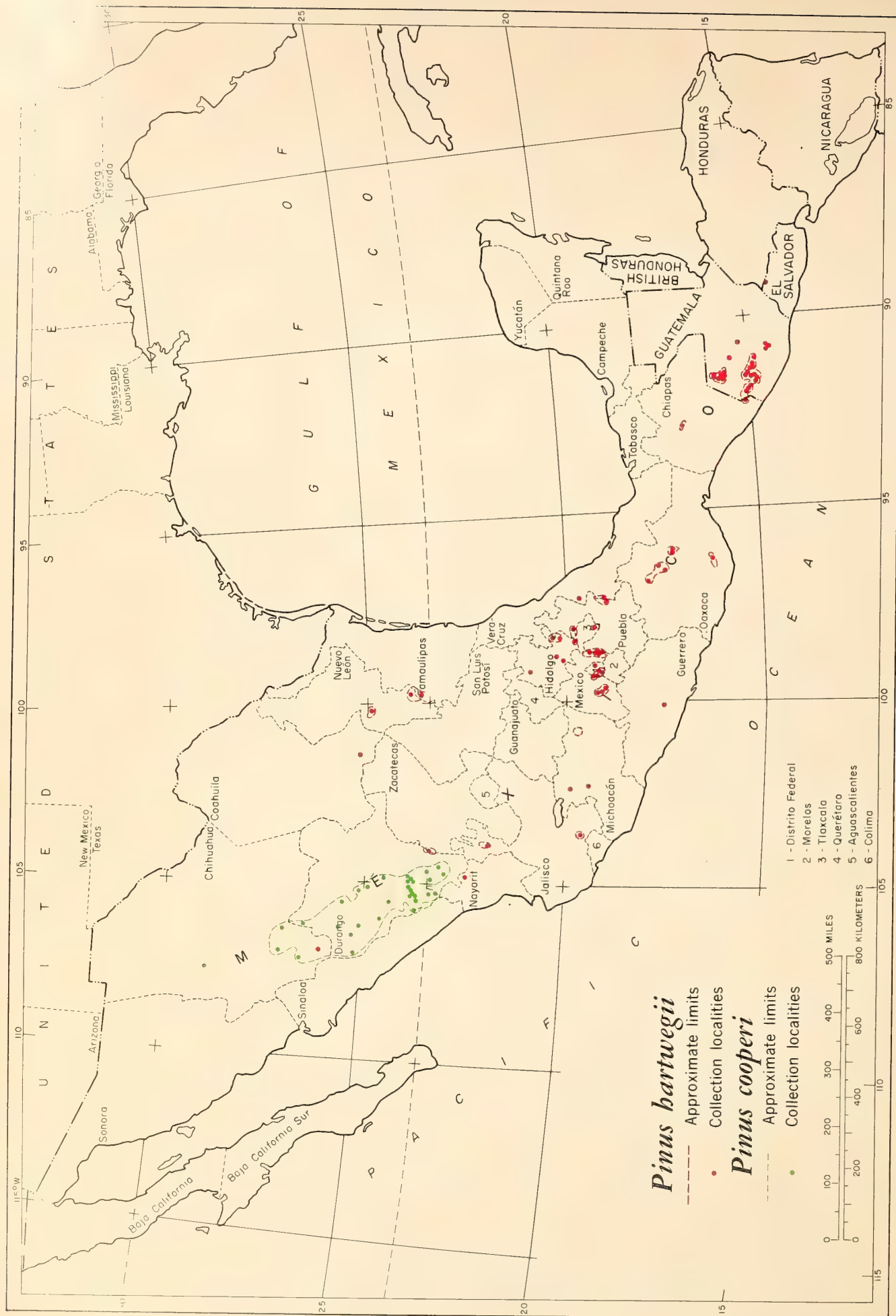


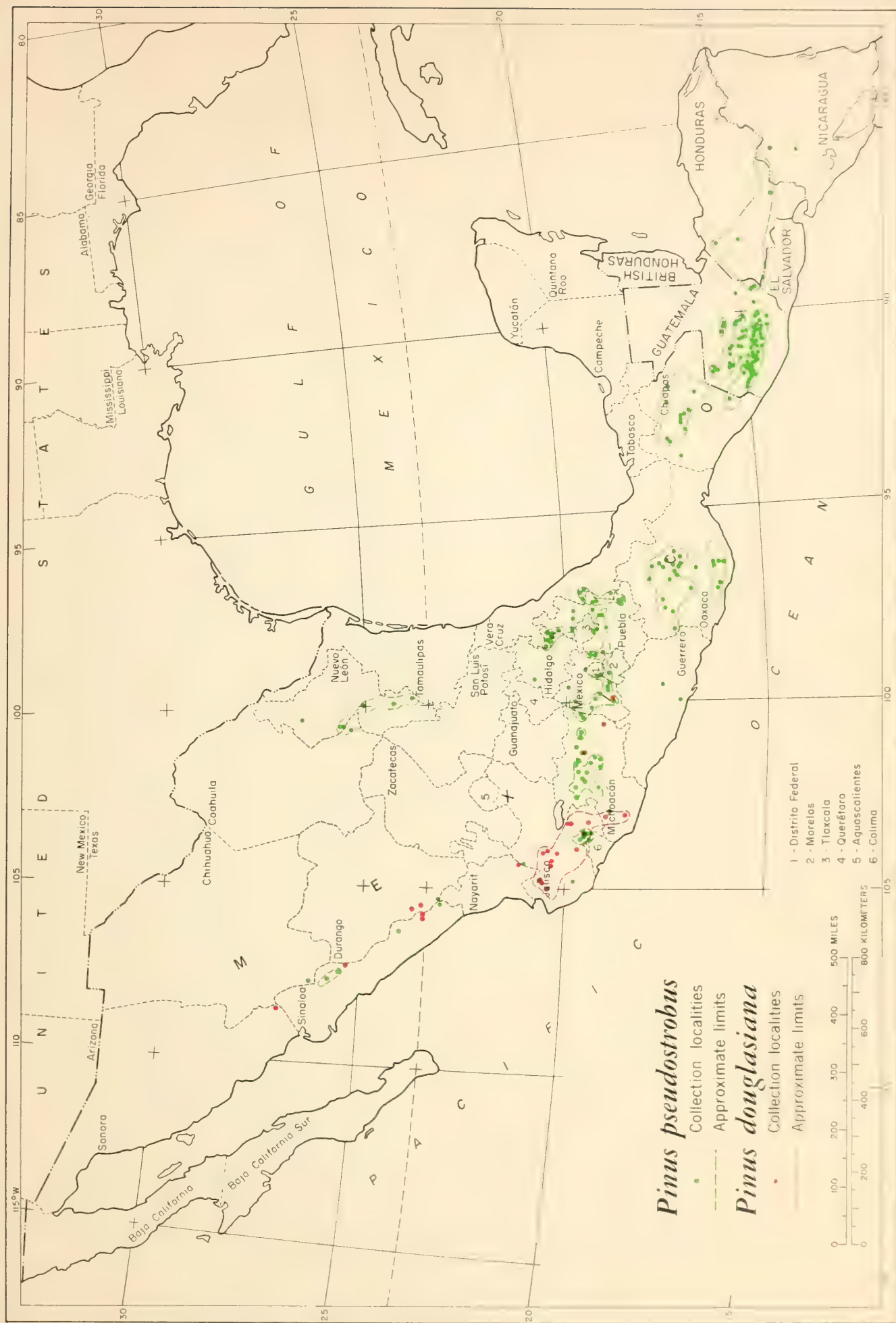
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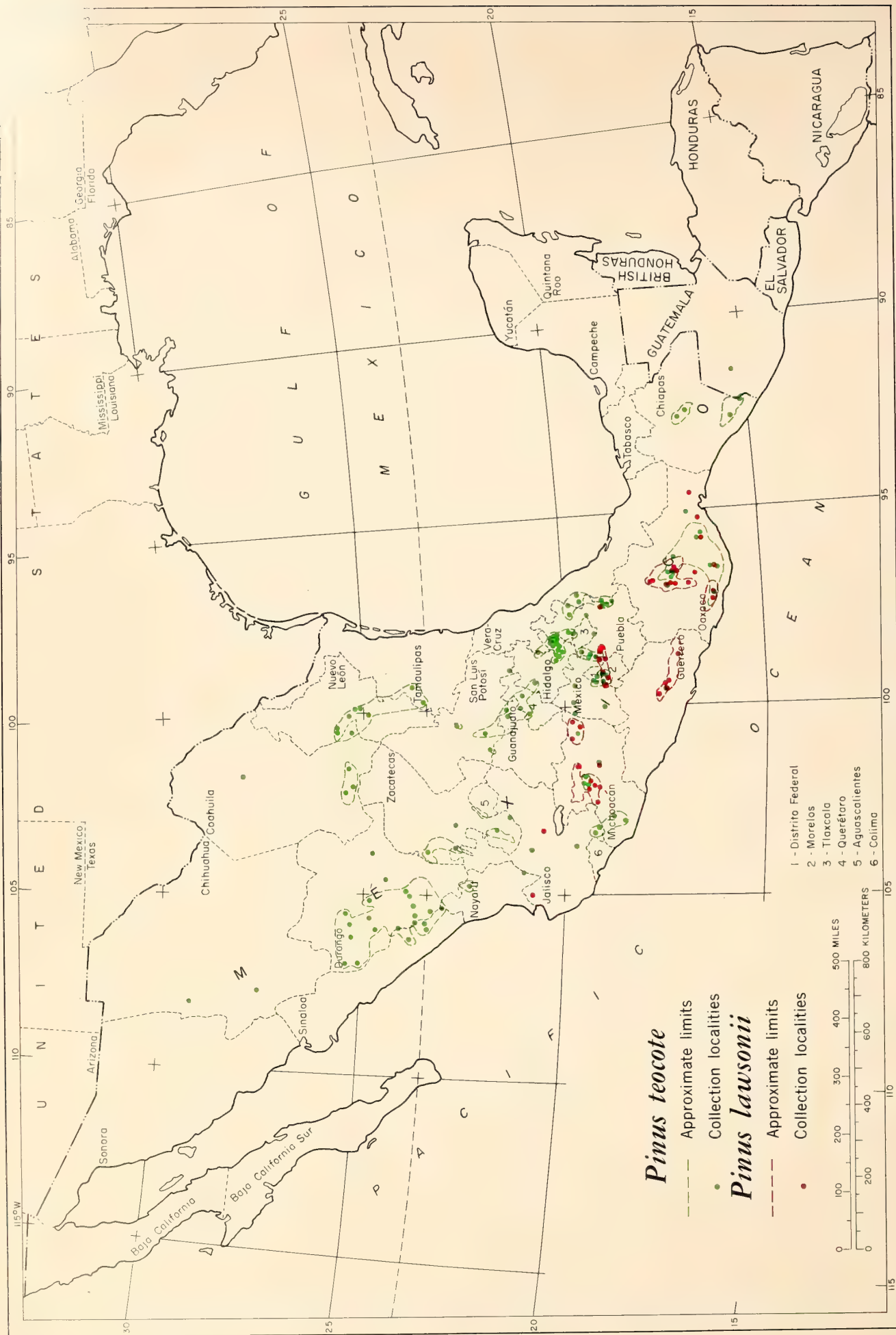
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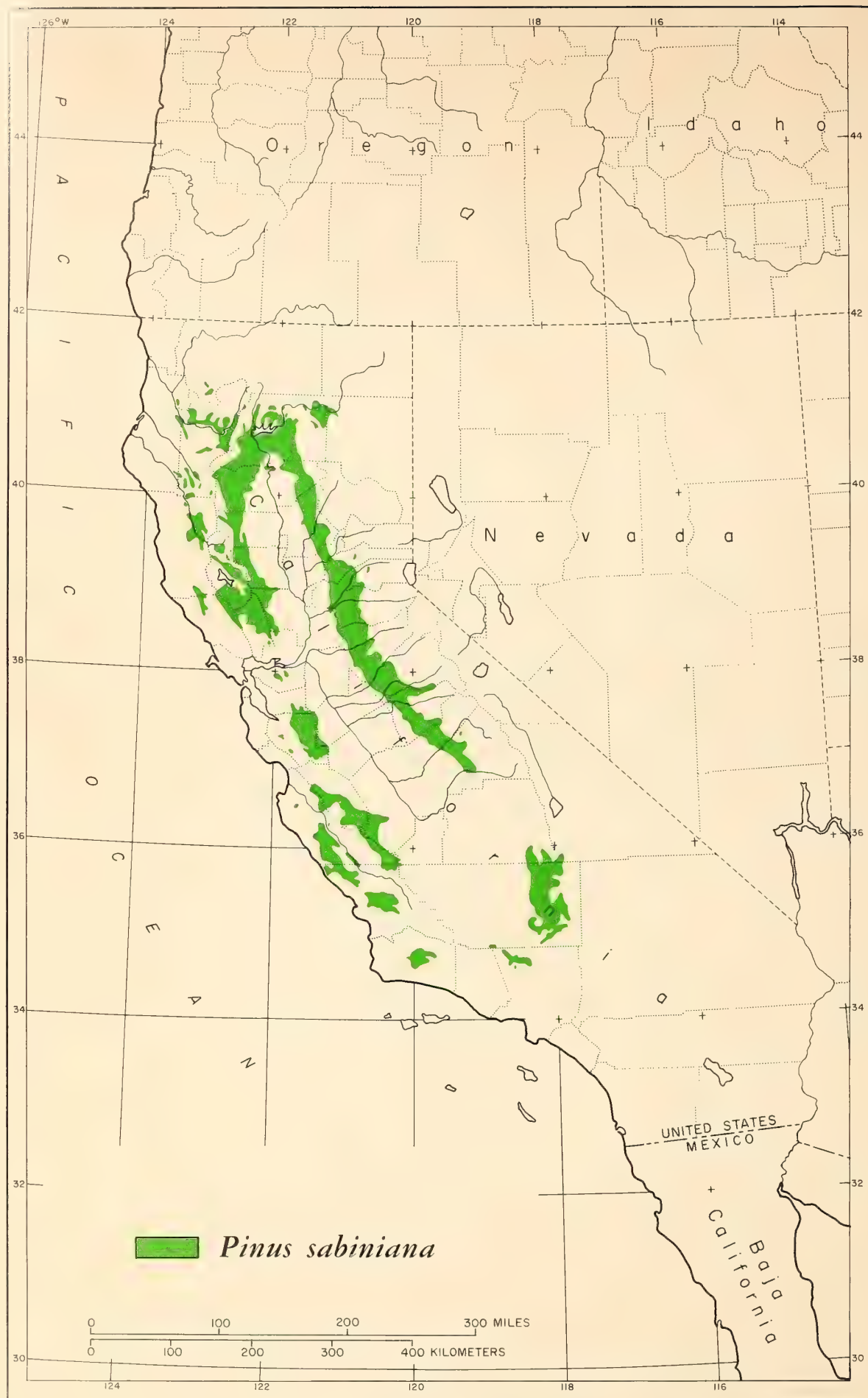




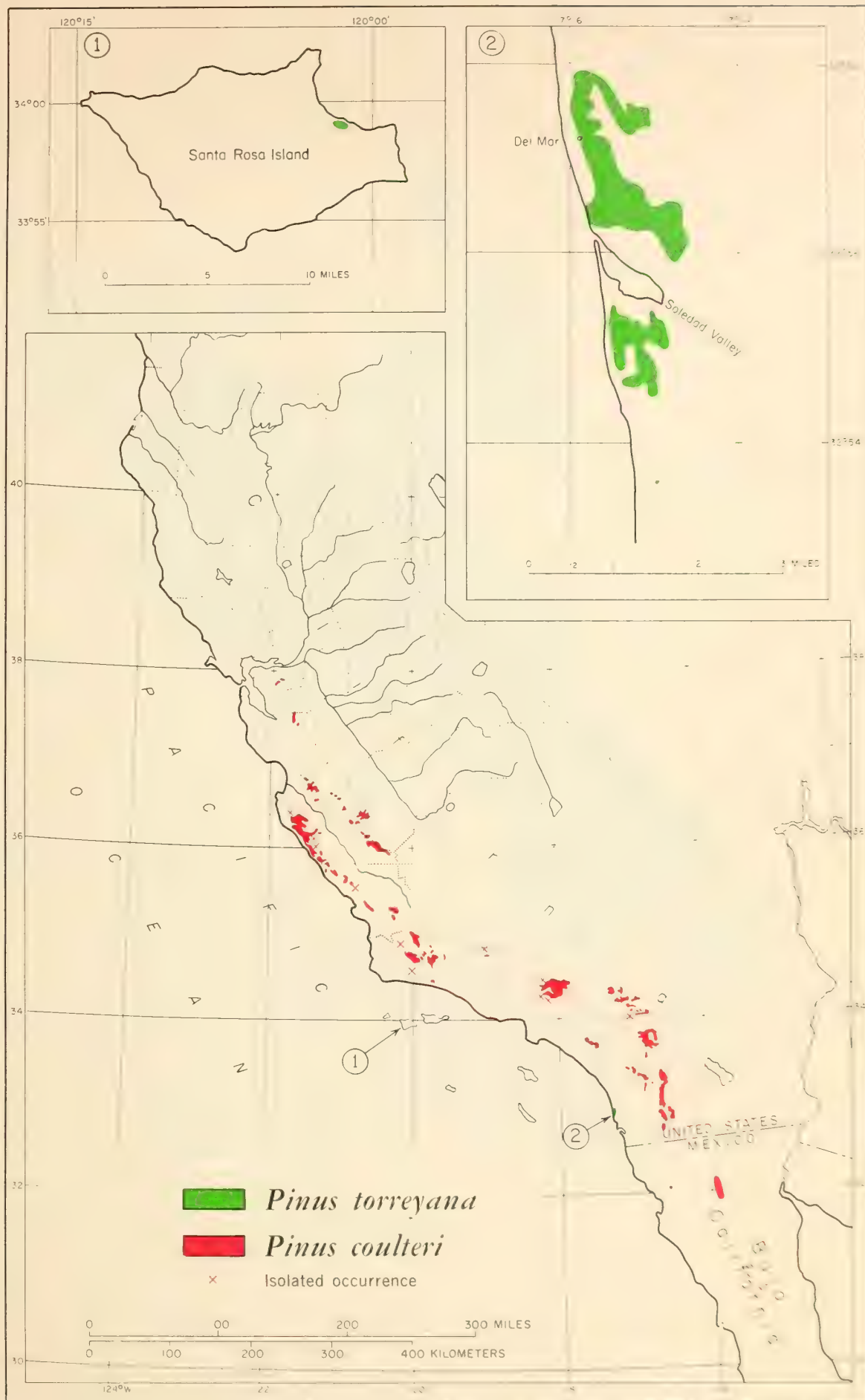
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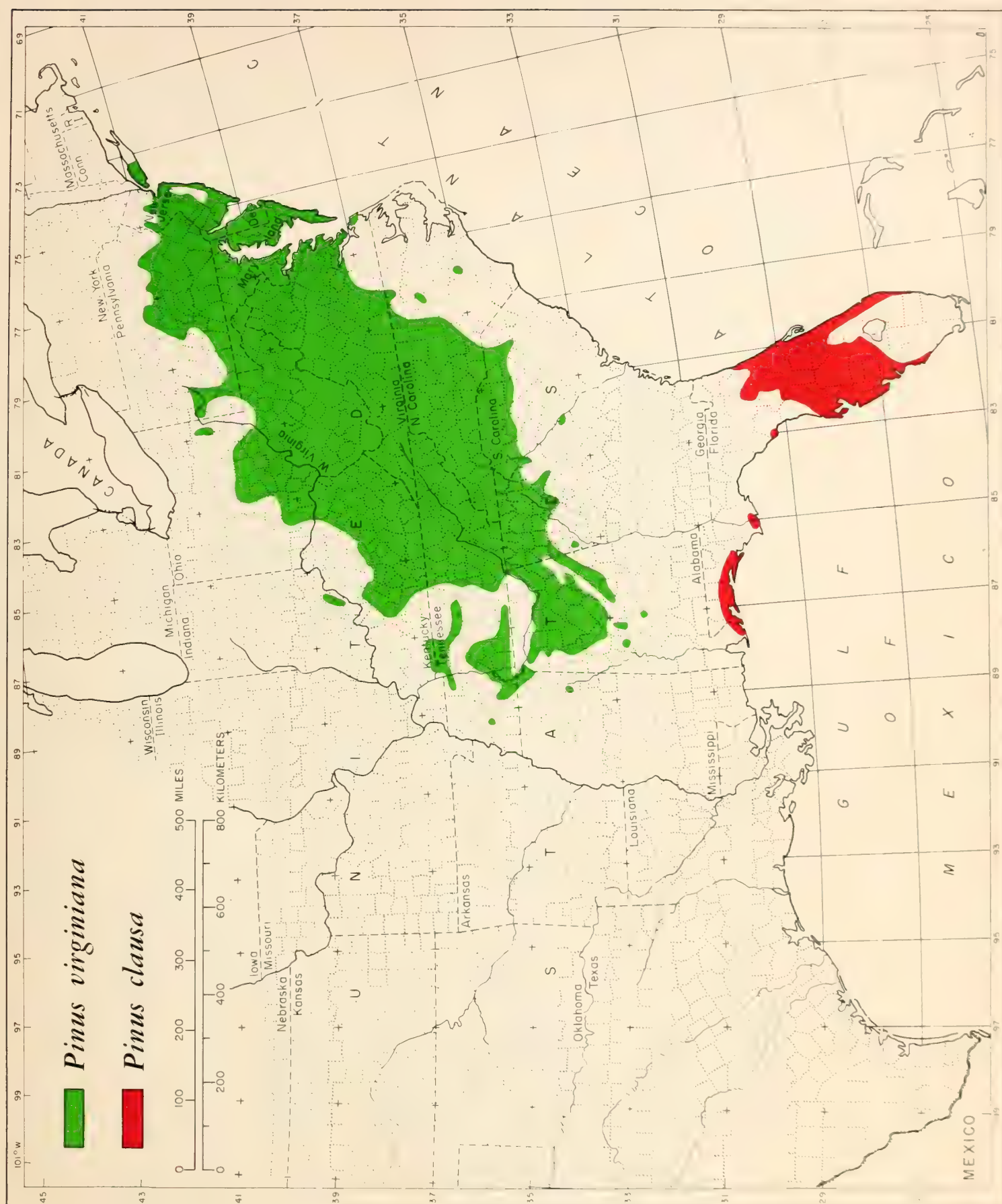
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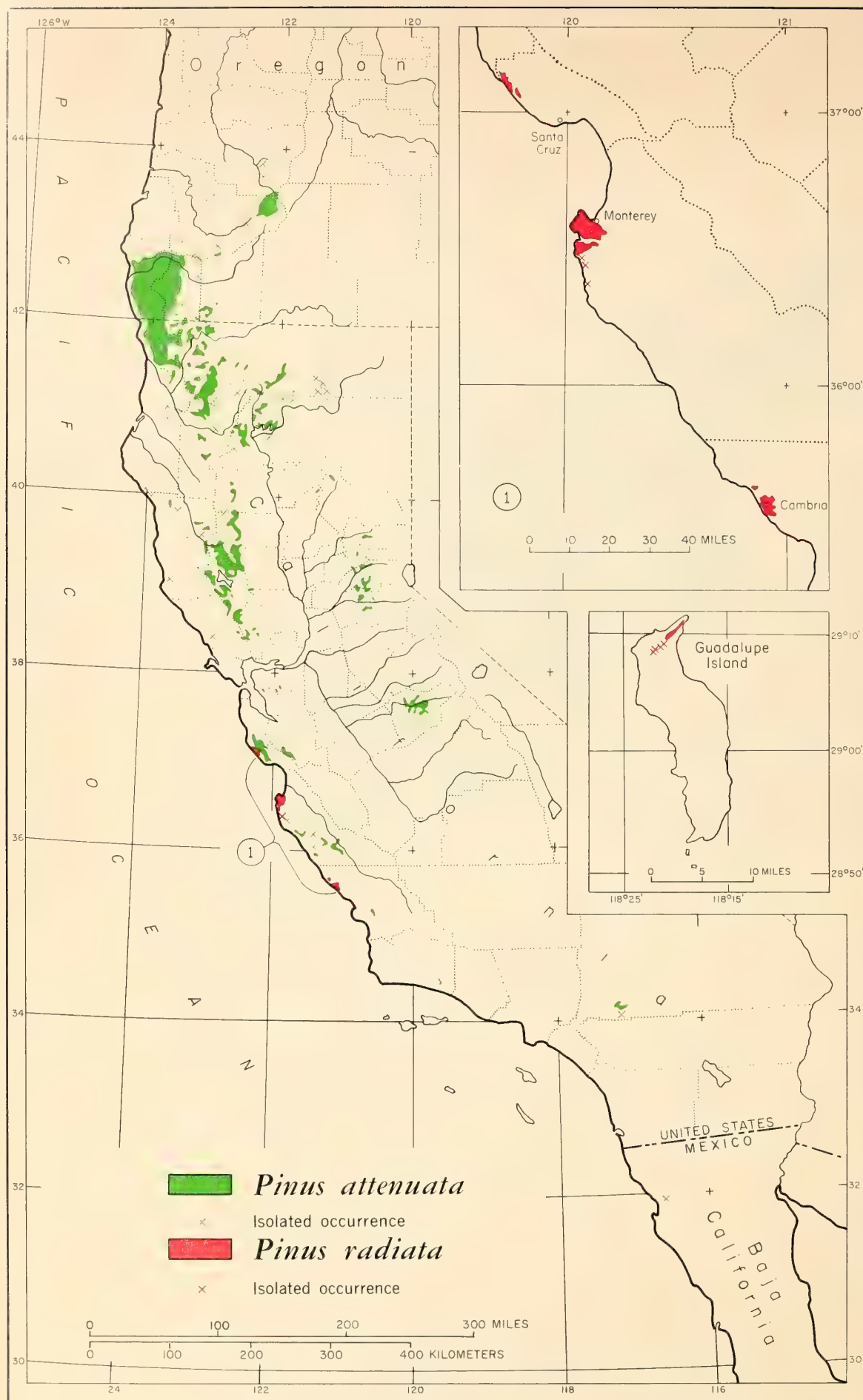
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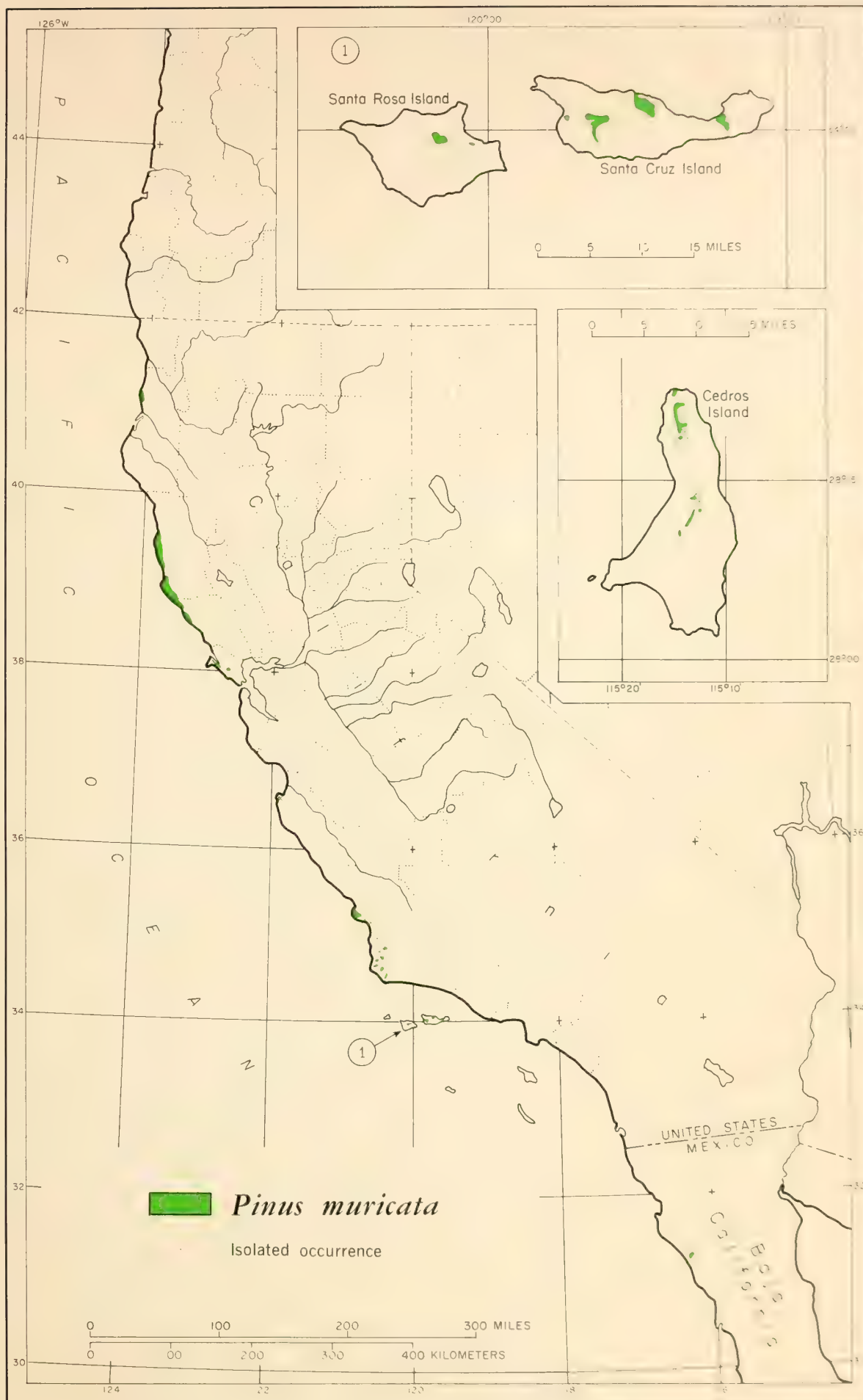
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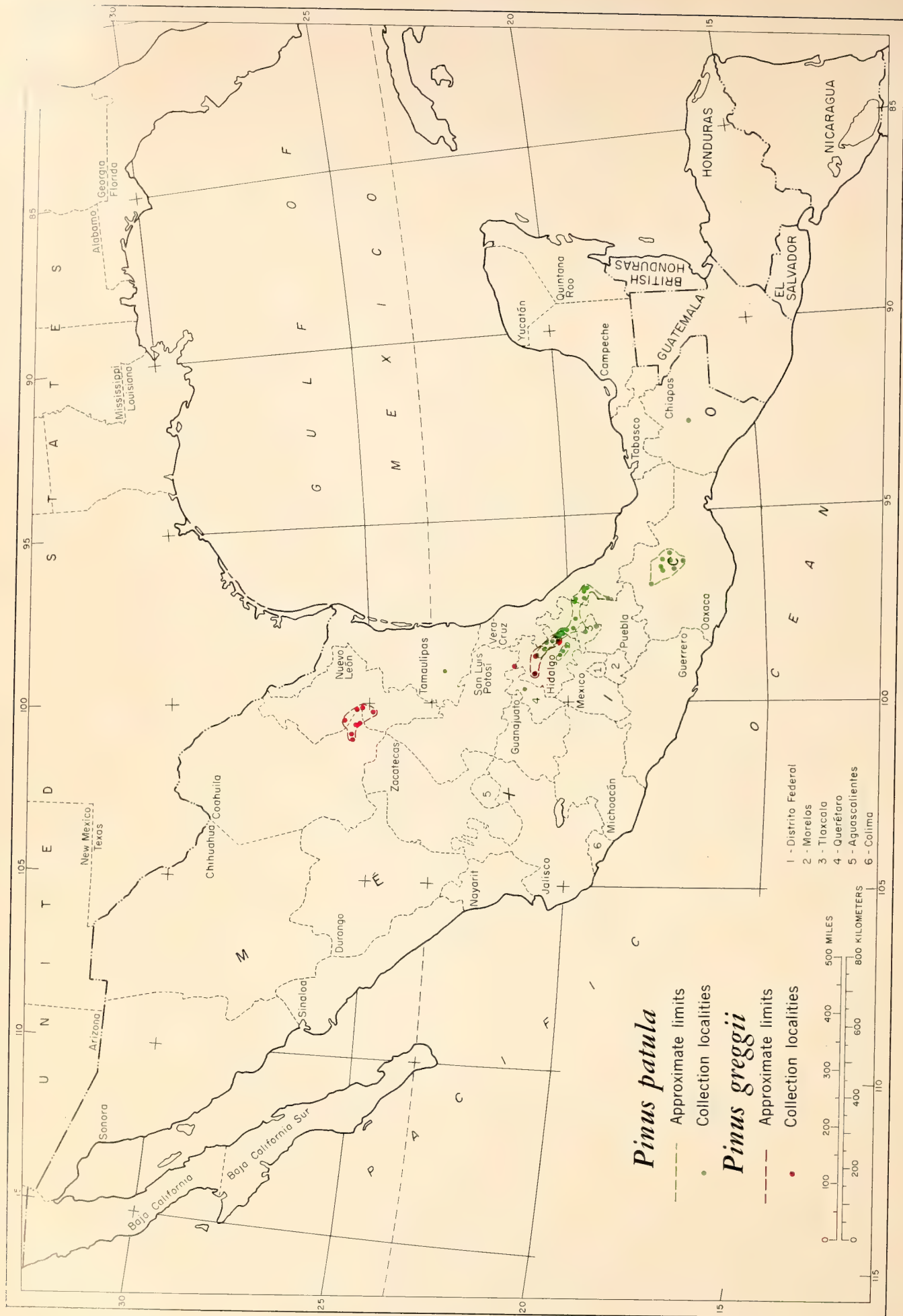
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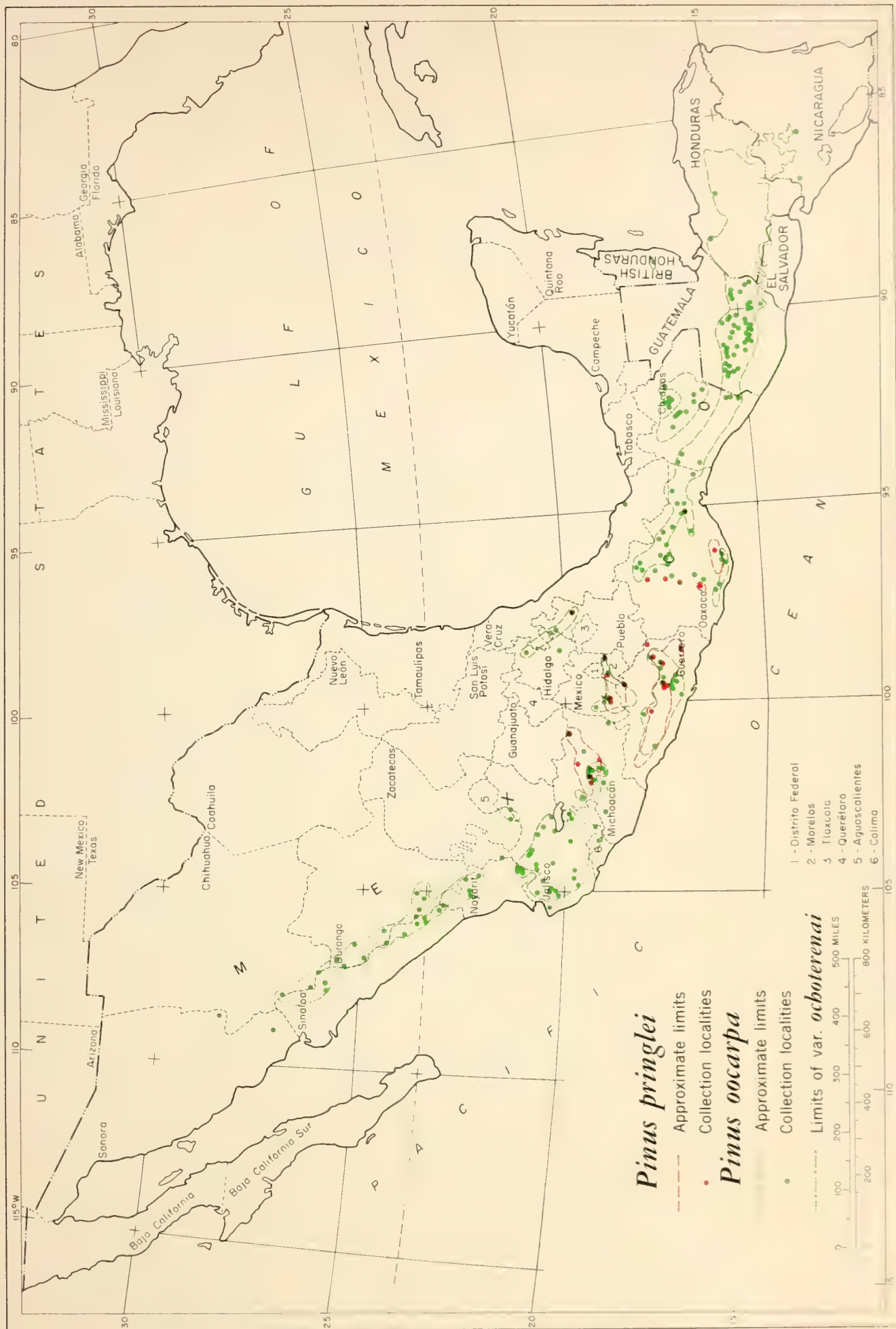


Map 58



Map 59





Map 61

INDEX OF SCIENTIFIC AND COMMON NAMES

Text page numbers and map numbers are given for the accepted specific names in *Pinus* and for the English common names under pine and pinyon. Cross references are added for scientific names mentioned or combined as synonyms.

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